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The Copper Number of Cellulose

New Facts Concerning Methods for Its Determination

By A. J. HALL, B.Sc., F.I.C., F.T.I.

THE copper number of a cellulosic material may be defined as the amount of copper (expressed in grams) which can be reduced from the cupric to the cuprous condition by one hundred grams of the cellulose under strictly defined conditions. This method of characterizing a cellulose was introduced by C. Schwalbe over twenty years ago (Ber., 1907, 40, 1347 and 4523) and is based on the fact that whereas a normal cellulose has practically no reducing action, a cellulose which has been overbleached or degraded in any manner shows marked reducing properties. The greater the degree of degradation the greater the copper number of the cellulose so that this test is convenient as a measure of the amount of damage to cellulose substances as produced in technical operations such as bleaching, dyeing, and printing, in which the cellulose comes into contact with strongly reactive chemicals.

From the time of its introduction there have always been difficulties attending the conditions under which the test should be carried out since it soon became evident that such conditions had an important influence on the resulting copper number. Schwalbe, in the course of his search for ideal conditions, so complicated the method with apparatus and method that the carrying out of the test became tedious and something to be avoided, if possible, in spite of the value of the results yielded. A modification by Braidy (Rev. gen. Mat. Col., 1921, 25, 35) which appeared more simple and less subject to personal error was therefore welcomed, and when later this same method was tested by the British Cotton Industry Research Association (Clibbens and Geake; J. Text., Inst., 1924, 15, 27) and finally adopted it was thought that at last the method for determining a copper number of cellulose had been settled once and for all. It is thus somewhat disconcerting to read a recent paper by E. Hagglund (Cellulosechemie, 1930, 11, 1) throwing strong doubts on the accuracy of the Braidy method and describing a modification of the original Schwalbe process. This new knowledge is interesting and appears to be the more valuable in that it now leads to a test which is more rapid than any yet proposed. The time is, therefore, now opportune for reviewing the methods now available for determining the copper number of a cellulose.

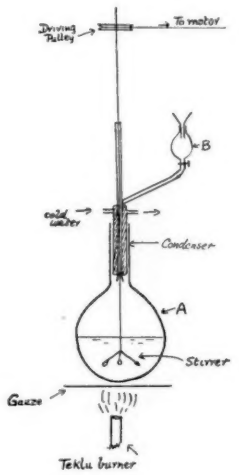

Figure 1.

However the test is carried out it is based on boiling or otherwise heating the cellulose with an alkaline solution of copper sulphate, filtering off the precipitated cuprous oxide formed and estimating the amount of copper in this oxide. The controversy is based on the details concerning the period of heating, the manner of heating, the composition of the copper sulphate solution (Fehling's solution), and the manner for ascertaining the amount of reduced

copper. If these details had but little effect on the result there would be no or but little controversy; unfortunately their effect is considerable.

The following is the Schwalbe method for determining the copper number as described by himself in his book ("Die chemische Betriebskontrolle in der Zellstoff—und Papier-Industrie." 1922, page 230). The apparatus employed is shown (without detail) in Fig. 1.

First 2 to 3 grams of the air dry cellulose and 250 c.c. of distilled water are placed in flask A which has a capacity of 1500 c.c. and heated to boiling. At the same time 50 c.c. each of solutions A and B are heated to boiling in separate flasks and then one added to the other and the mixture immediately poured into flask A through the dropping funnel B; then this funnel is washed down with 50 c.c. of hot water. The mixture in flask A quickly regains boiling and 15 minutes are allowed for the action of the Fehling's solution on the cellulose from the moment boiling re-commences. The condenser and stirrer are then removed, being washed down with distilled water, and the contents of flask A filtered. Before filtration, which is carried out through a Buchner funnel in the usual manner, it is sometimes advisable to add to the contents of flask A about 1 gram of purified kieselguhr; this may assist filtration of the cuprous oxide but in many cases the addition is unnecessary.

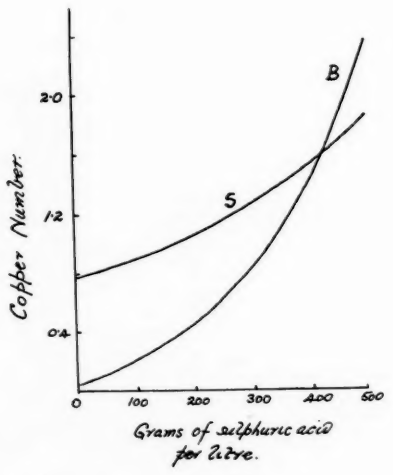

Figure 2.
S—Schwalbe method.
B—Braidy method.

The residue on the filter (cellulose, cuprous oxide, and kieselguhr) is then transferred to a porcelain dish and heated with a 6.5% solution of nitric acid to dissolve the copper compounds, the product being then filtered again. The final removal of a soluble copper nitrate or other salt in the residue on the filter is effected by washing with hot water following by washing with dilute ammonia. The copper in the combined filtrates is then determined by an electrolytic method.

Solutions A and B which in equal mixtures form Fehling's solution have the following composition:

Solution A. 692 grams of Rochelle salt and 200 grams of pure sodium hydroxide dissolved to a volume of 2 litres.

Solution B. 138.6 grams of copper sulphate dissolved to a volume of 2 litres.

From the above method is obtained the "uncorrected" copper number. This distinction from the "corrected" copper number is necessary because it has been recognized that the residue obtained by filtering the contents of flask A after the 15 minutes' boiling contains not only cuprous oxide but also a small proportion of unreduced copper sulphate absorbed by the cellulose. An approximation to this absorption is obtained by steeping 2 to 3 grams of the same cellulose for 45 minutes in a cold mixture of 300 c.c. of water and 50 c.c. each of solutions A and B, then filtering, and the residue treated as in the determination of the copper number for the estimation of the amount of absorbed copper present. This amount of copper is then deducted from the "uncorrected" copper number in order to obtain the "corrected" copper number.

Instead of using an electrolytic method for estimating the reduced copper E. Hagglund introduced a modification whereby this can be avoided. Hagglund thoroughly washes the residue on the filter with a solution containing per litre, 50 grams of ferric sulphate and 200 grams of sulphuric acid, so that the cuprous oxide present rapidly reduces its equivalent of ferric iron thus:

$$Cu_2O+Fe_2(SO_4)_3+H_2SO_4=2CuSO_4+2FeSO_4+H_2O$$

and the filtrate contains a certain amount of ferrous iron which can be rapidly and simply estimated by titration with a standard potassium permanganate solution. It is obvious that the Copper Number obtained in this manner is the "corrected" Copper Number since the absorbed unreduced copper sulphate exercises no reducing action on the ferric sulphate solution.

A similar method involving the use of a ferric iron solution (iron alum dissolved in dilute sulphuric acid) has also been suggested by Knecht and Thompson (J. Soc. Dyers and Col., 1920, 36, 255) and obviously has the same advantages.

We may now turn to the Braidy method which has been critically examined by Clibbens and Geake (J. Text. Inst., 1924, 15, 27). The two solutions A and B used in this case for preparation of a Fehlings solution (the use of two separate solutions is necessary since Fehlings solution itself gradually decomposes on storage) are as follows:

Solution A. 100 grams of copper sulphate cryst. dissolved to one litre.

Solution B. 50 grams of sodium bicarbonate and 350 grams of sodium carbonate cryst. dissolved to one litre.

In carrying out the test 5 c.c. of solution A are added to 95 c.c. of solution B, the mixture raised to the boil and poured over 2.5 grams of the cellulose being examined and contained in a conical flask of 100 c.c. capacity. After thorough mixture of its contents the flask is closed with a pear shaped bulb and immersed deeply in a rapidly boiling water bath for exactly three hours. The product is then filtered and the cotton residue (impregnated with cuprous

oxide) is washed first with dilute sodium carbonate solution and then with hot water. The cuprous oxide is then dissolved by washing the residue on the filter with the following solution C:

Solution C. 100 grams of iron alum and 140 c.c. of concentrated sulphuric acid dissolved to one litre.

Usually two separate portions of 15 and 10 c.c. of this solution are sufficient to dissolve the cuprous oxide completely. After washing further with 2N sulphuric acid the combined filtrates are titrated with N/25 potassium permanganate solution.

It is evident that the main difference between the Fehlings solution used in the Schwalbe and Braidy methods is that in the first named method no caustic soda is present.

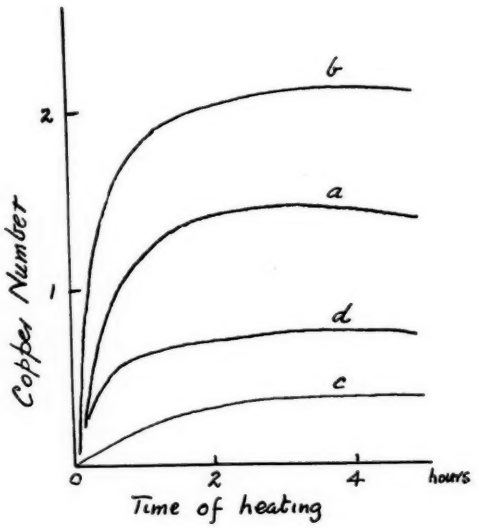

Figure 3.

Clibbens and Geake state that the Braidy method has the following advantages: In the absence of all cellulose material it gives a very low and constant "blank." Also pure cellulose yield very low Copper Numbers (values as low as 0.005 were obtained for samples of well scoured cotton fabrics), and the results can be accurately reproduced. The Braidy method is considered more sensitive than the Schwalbe method, probably due to the absence of caustic alkali from the Fehling-solution, it being recognized that the reducing properties of modified celluloses are affected by boiling caustic soda. This increased sensitivity is shown in Fig. 2 which gives the Copper Numbers as obtained by both methods for a series of cottons attacked by increasing concentrations of sulphuric acid; the curve of the Braidy Copper Numbers is steeper.

Even in this Braidy method careful attention to the details of carrying out the test appear to be necessary. Thus it is desirable always to use the sample weight (2.5 grams) of the cellulose being examined. If the weight used in 1 gram instead of 2.5 grams then lower Copper Numbers are obtained as indicated in the following table of results:

	Copper Number	
Cellulose sample	1 gram sample	2.5 gram sample
1	0.80	0.87
2	2.21	2.33
3	3.09	3.48
4	3.92	4.36

Also if a low barometric pressure exists then the boiling point of the Fehlings solution will be lowered proportionally and this exerts an effect on the Copper Number. Clibbens and Geake estimate that a lowering of temperature of 1.5 C. (corresponding to a barometric pressure reduction of 40 mm.) would cause an error of 5 to 10 per cent in the Copper Number.

The new method described by Hagglund is carried out in the following manner:

One gram of the air dry cellulose is boiled for 3 minutes exactly with 40 c.c. of a Fehlings solution prepared by mixing 20 c.c. each of the following solutions:

Solution A. 62.5 grams of copper sulphate dissolved to one litre.

Solution B. 200 grams of Rochelle salt and 150 grams of caustic soda dissolved to one litre.

The product is then poured into a porcelain dish and cooled; afterwards it is filtered on a Buchner funnel under suction and well washed with hot water. The residue is then treated with small portions at a time of an acidified solution of ferric sulphate (50 grams of ferric sulphate and 200 grams of concentrated sulphuric acid per litre) and the combined filtrates and washings, containing an amount of ferrous iron equivalent to the cuprous oxide formed in the test, are then titrated with a standard solution of potassium permanganate. Unlike the original procedure for carrying out the Schwalbe test this new method requires no special apparatus and means of stirring.

The following results indicate that the Copper Numbers obtained by the new method agree closely with those obtained by the Schwalbe method:

	Copper Number	
Cellulose material	Hagglund	Schwalbe
Sulphite cellulose B	1.4	1.35
" " C	1.45	1.35
" " D	1.4	1.3
" " E	1.55	1.5
" " bleached	0.35	0.25
Hydrocellulose	4.0	5.0

Hagglund criticises the Braidy method chiefly on account of the large influence on the resulting Copper Number which the conditions of time and temperature play. Thus it makes a considerable difference whether the flask (in the Braidy method) is heated *on* or *in* the water bath. The following results indicate this clearly:

Cellulose, and conditions of test	Copper Number Hours of heating						
	½	1	1½	2	3	4	5
Sulphite cellulose							
(a) *on* water bath	0.8	1.2	1.25	1.45	1.5	1.4	1.4
(b) *in* " "	1.45	1.8	1.95	2.0	2.15	2.15	2.1

Cotton								
(c) *on* water bath	0.15	0.2	0.3	0.35	0.35	0.35	0.35	
(d) *in* " "	0.5	0.6	0.7	0.7	0.7	0.7	0.75	

The above results are also shown clearly in Fig. 3, but Hagglund gives some further evidence of the considerable influence of the conditions of heating as follows:

	Copper Numbers							
Cellulose	Conditions of heating in the test							
	3 hrs. *on* water bath	3 hrs. *in* gently boiling water bath	1 hrs. in vigorously boiling water bath	2	3	4	5	6
Sulphite cellulose	1.4	1.9	2.1	2.5	2.8	3.0	3.2	3.4
Sulphite cellulose	...	0.7	...	1.0	1.4	1.5	1.6	...

In contrast to this the new method is much less susceptible to the influence of the time factor. Even when the time of boiling is increased from 3 to 5 minutes (a 66 per cent increase) the Copper Number was shown to be unaffected. With more prolonged heating the Copper Number increases but not markedly as below:

	Copper Number							
	Time of heating in minutes							
Cellulose	3	5	6	10	15	20	30	40
Sulphite cellulose	1.35	1.35	....	1.5	...	2.6	...	5.2
Cotton	0.45	....	0.55	0.65	1.2	1.6	...	...

It was of course recognized by Clibbens and Geake that the Braidy method was influenced by the time of heating and they actually determined the extent of this influence by carrying out determinations over a period of 5 hours. The results, shown in Fig. 4, indicated that as the time of heating was increased the Copper Number reached a limiting value.

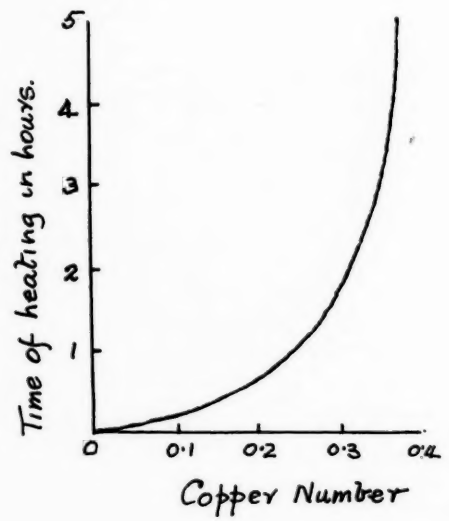

Figure 4.

On comparing the methods now available it would appear that the new Hagglund method offers definite advantages, particularly as regards the time occupied in carrying out the test. The boiling only occupies three minutes and the use of a ferric sulphate solution in the estimation of the amount of reduced cuprous oxide makes the subsequent routine both more rapid and accurate. It is urged against the use of a Fehlings solution containing caustic soda that during boiling auto-reduction occurs between the components of the solution independently of the effect of the cellulose present. In a boiling of 15 minutes the amount of this auto-reduction can be considerable but now that the time is cut down to but 3 minutes it would seem that the error introduced in this manner will be negligible. Experience with the new method will reveal any unsuspected faults that it may have but at the moment it would appear to the best method now available for detecting degradation in cellulose materials.

Swann Chemical Company Formed

Theodore Swann, president of the Swann Corporation of Birmingham, Ala., has announced the merger of seven individual companies into a central organization which is to be known as the Swann Chemical Company and to have a capitalization of $1,000,000 and a surplus of approximately $1,800,000.

The companies which have been absorbed in this merger are the Federal Phosphorus Co., Southern Manganese Corp., Southern Manganese Mining Corp., Southern Manganese Land Co., Federal Carbide Co., and Jax Plant Food Co. All of these, with the exception of the Federal Phosphorus Co., which will be retained as a division for the sale of phosphoric acid and phosphates, will be superseded in name by the Swann Chemical Co.

The officers of the newly-formed company are as follows: Theodore Swann, president; E. L. Sayers, vice president in charge of operations and engineering; B. G. Klugh, vice president, John A. Chew, vice president; Robert S. Weatherly, sales manager; C. M. Jesperson, secretary and treasurer; E. T. Hall, assistant secretary and assistant treasurer; Alma Lide, assistant secretary and assistant treasurer.

R. & H. Outing

The third annual outing of the Roessler & Hasslacher Chemical Co. was held at Narragansett Inn, Lindenhurst, L. I., on Saturday, May 24th.

One hundred and sixty employees of the company attended and there was a very varied program, including a baseball game between the single and married men, running races and a tug-of-war. Luncheon and dinner was served and a short address was made by Milton Kutz, executive vice-president in charge of the New York office. Many members of the company attended from the Brooklyn warehouse and the branch offices.

The committee in charge was Miss R. Zundell, and Messrs. R. Schmidt, J. F. Schwartz, and W. Friesendorf.

Elementary Textile Microscopy

Part II—Methods

Longitudinal Mounts—Preparation—Mounting Media—Air Mounts—Water Mounts—Canada Balsam Mounts—Glycerine Jelly—Cross Sections—Steps—Cementation—Embedding—Cutting—Mounting—Quicker Methods

By **JOHN H. SKINKLE**

Department of Chemistry, Lowell Textile Institute

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(Continued from issue of May 26, 1930.)

IN MOUNTING fibers, the first step in their preparation is to remove the natural waxes or greases and any dirt by a scouring process. Vegetable fibers may be scoured with sodium carbonate or any other dilute alkali, but animal fibres and rayons should be cleaned with dilute soap solution. Since some of the vegetable fibers contain bastose—a substance sensitive to alkalies—it would be safer, especially in the case of an unknown fiber to do all the scouring with soap.

In order to be more easily visible, the fibers are then dyed by boiling a few minutes in a solution of a suitable dyestuff. Vegetable fibers and rayons are dyed with the direct cotton dyes and animal fibers are dyed with acid dyes to which a few drops of dilute acid are added. Acetate rayon is not dyed by either class of dye, but may be colored by basic dyes or by special dyes—such as the SRA colors—especially made for this type of rayon. The color to dye the fiber varies with the use to which it is to be put. For ordinary visual work, a green dye is used, partly because the eye is more sensitive to this color, but principally because achromatic objectives are corrected for this portion of the spectrum. When the fibers are prepared for photomicrography, a red dye is more suitable because red photographs as black on orthochromatic plates and greater contrast may be obtained.

For rapid work, both the scouring and dyeing operations may be omitted; but for permanent mounts, both are desirable.

Longitudinal Mounts—Mounting Media

In selecting a mounting medium, the following desirable properties should be sought:

1. The refractive index should vary considerably from that of the substance mounted, otherwise there would be no clear line of demarcation between object and medium.
2. The medium should be colorless, or nearly so.
3. The medium should be chemically inert to the substance mounted.
4. The medium should preferably act as a preservative of the substance mounted.

A list of the more common media with their refractive indices is given in Table II but directions for the use of air, water, Canada balsam, and glycerine jelly alone will be given since these are the most commonly used media.

TABLE II

Mounting Media

Medium	*Refractive Index*
Air	1.00
Water	1.33
Glycerine	1.46
Glycerine Jelly	....
Paraffin Oil	1.47
Castor Oil	1.49
Canada Balsam in Xylol	1.52
Alpha-monobromnaphthalene	1.66

Longitudinal Mounts—Air Mounts

Fibers are sometimes placed on a slide and a cover glass added, especially when diameter measurements are to be made on fibers which might swell in a liquid; but such mounts are quite unsatisfactory for general use, since the fiber is bent by the weight of the cover glass and the various portions of the fiber are not in the same plane and hence not visible without numerous readjustments of the focus.

Longitudinal Mounts—Water Mounts

Water mounts of fibers from a visual standpoint are perfectly satisfactory, the mounts, however, are not permanent and must be made up fresh for each new com-

parison. They are made by teasing out a few fibers onto a slide, adding a drop of water, and lowering a cover glass (at an angle to prevent the trapping of air bubbles) onto the drop. Water mounts are very rapidly made, since no dehydrating or staining is necessary and are therefore much used.

LONGITUDINAL MOUNTS—CANADA BALSAM MOUNTS

Canada balsam mounts are very satisfactory and have the advantage of being permanent so that prepared mounts may be kept for reference.

The steps in preparing a balsam mount are: removing the water (dehydrating), hardening the fiber (fixing), making the fiber transparent (clearing), and mounting. A list of the most common dehydrating, fixing, and clearing agents is given in Table III, but alcohol as a dehydrating and fixing agent and xylol as a clearing agent are most used and easiest to use for textile purposes.

TABLE III

DEHYDRATING, FIXING, CLEARING AGENTS

Dehydrating Agents	*Clearing Agents*
Ethyl Alcohol	Cedarwood Oil
Fixing Agents or Hardeners	Oil of Cloves
Ethyl Alcohol	Oil of Bergamot
Formaldehyde-Acetic Acid	Oil of Wintergreen
Chromic Acid	Terpineol
Formaldehyde	Xylol
Mercuric Chloride	Chloroform
Iodine	Turpentine
Picric Acid	Benzene
	Paraffin Oil

The dyed fiber is immersed in absolute alochol, preferably by steps from 25% alcohol through gradually higher concentrations to full strength, then immersed in xylol for a few minutes. A few fibers are teased out onto a slide, a drop of Canada balsam is added and a cover glass dropped on top. After twelve to twenty-four hours, the Canada balsam is hard and the slide may be safely handled in any position.

LONGITUDINAL MOUNTS—GLYCERINE JELLY

Glycerine jelly, the directions for making which may be found in Table IV, is satisfactory, and if correctly made, the mounts are permanent. These mounts are somewhat more troublesome to make and are, therefore, not in general use except for some classes of cross-sections, as will be seen later.

TABLE IV

FORMULAE

Canada Balsam

Dry the balsam on a water-bath until brittle when cooled, then to each 200 grams of balsam add 100 cubic centimeters of xylol.

Glycerine Jelly

Soak 2 parts of gelatine in water until soft; then drain, melt, add 3 parts of glycerine, and filter.

Albumen Fixative

Shake well together 50 cc. of egg albumen, 50 cc. of glycerine, and 1 gram of sodium salicylate; then filter.

Millon's Reagent

Dissolve 1 cc. of mercury in 10 cc. of concentrated nitric acid, add 10 cc. of water. This must be used while fresh.

Diphenylamine Reagent

Dissolve 1 gram of diphenylamine in 100 grams of concentrated sulfuric acid.

Aniline Sulfate Reagent

Dissolve 2 grams of aniline sulfate (aniline salts) in 100 cc. of water.

Methylene Blue

Dissolve 0.1 gram of methylene blue in 100 cc. of water. This should be used cold for 15 minutes to detect oxycellulose.

Sudan III

Make a saturated solution of the dye in absolute alcohol. Treat the fiber 10 minutes with this in the cold, then rinse with alcohol to test for presence of fat or oil.

A slide is mounted on a turn-table and with a brush dipped in cement a circular cell is built up. The dyed but not dehydrated fiber is placed in the cell, a drop of melted glycerine jelly is added, a cover glass is placed on top, and the cover glass is then sealed air-tight by means of more cement. If the sealing is not properly done, evaporation of the water will take place and the mount will become cloudy and unsatisfactory.

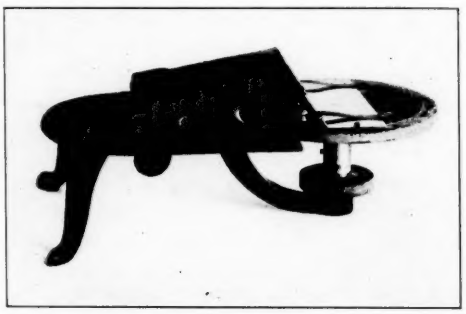

Figure 31. Turn Table

CROSS-SECTIONS—STEPS

In preparing a cross-section the following steps must, in general, be made:

1. Staining—this may be done either before or after cutting, preferably first of all. It is carried out in the same manner as for longitudinal mounts.
2. Dehydrating, fixing, and clearing—these steps are carried out as in preparing longitudinal mounts.
3. Cementation—the binding together of the component fibers into a compact, slightly rigid bundle.
4. Embedding—surrounding the bundle of fibers with a rigid but easily cut solid to support it during the cutting operation.
5. Cutting the bundle of fibers at right angles to its long axis at very small intervals (usually 10 microns or 1/100 of a millimeter).
6. Mounting the section on a slide and, if necessary, removing the embedding material.

CROSS-SECTION—CEMENTATION

The previously dyed, dehydrated, fixed and cleared yarn

or bundle of fibers is immersed for a few minutes in collodion, then dried for a short time in warm air, to harden the collodion. The purpose of this treatment is to make the bundle of fibers slightly rigid so that a sweep of a cutting blade will cut all the fibers at the same angle. In the case of a yarn which is being examined for penetration, this cementation holds the component fibers in their true relative positions during subsequent operations. The drying of the collodion must not be carried too far or the bundle will become too hard to cut well.

Cross-Sections—Embedding

Embedding is carried out by holding the cemented bundle of fibers in a fixed position while melted embedding medium is poured around it in a form. After the solidification of the embedding substance, the form is removed and the block containing the bundle passing through its long axis is trimmed down until about one-half inch square at the ends.

The embedding material generally used is paraffin of high melting point (135-140° F.) but occasionally glucose-gelatine mixture is used.

The form used for holding the paraffin or glucose-gelatin may vary. A test tube may be used, if one end of the yarn or bundle is held at the bottom by a weight, a small cardboard box with slits cut in opposite ends to hold the bundle of fibers is fairly quick and serviceable; or four metal Ls may be used to make a small box in two sections, between which is held the bundle of fibers (see accompanying illustration).

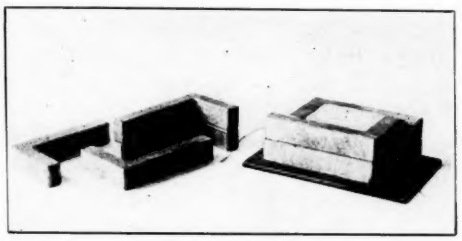

Figure 32. Embedding Blocks

Cross-Sections—Cutting

Cutting the cross-section may be done by one of the three methods:

1. Hand cutting—in which the operator estimates the thickness of the section and cuts it.
2. Semi-automatic microtome—in which the operator cuts the section off with a hand razor but the thickness of the section is determined by the microtome.
3. Automatic microtome—in which the operator simply turns a crank and the machine both cuts and determines the thickness of the section.

In hand cutting of fiber sections, the use of the old-fashioned razor is unnecessary since safety razor blades with the reinforced back, such as the Gem or Ever-Ready, may be used a few times and thrown away in place of the laborious and time-consuming honing and stropping of the straight-edge razor. The cutting is best done on a piece of soft wood. One end of the blade is rested on the wood and the edge of the blade passes, at a slight angle, along the face of the block. With practice, quite thin sections may be cut and for quick results this method is satisfactory, but for really good sections the microtome should be used.

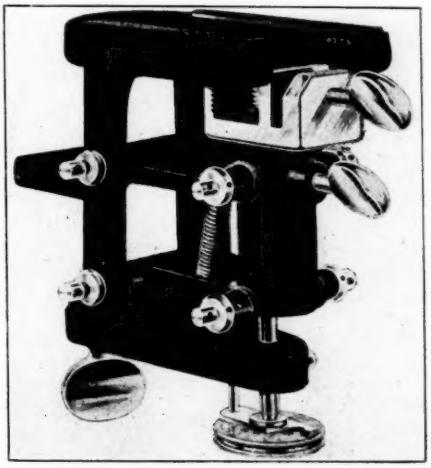

Figure 33. Table Microtome

The semi-automatic microtome consists of a clamping device for holding the sample which is moved toward the cutting surface by means of a calibrated screw mechanism. The calibrations of the screw are usually as fine as 2.5 or 5 microns (.0025 to .005 millimeters). The actual cutting is done by running a razor along some guides at a slight angle to the face of the sample. After each stroke of the razor, the screw mechanism is moved forward the correct amount and another stroke is made.

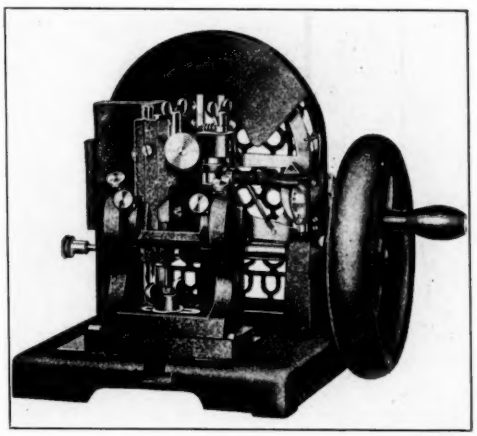

Figure 34. Minot Rotary Microtome

Automatic or precision micrometers of all kinds are on the market and, while they all work on the same principle, all are structurally quite different. A description of the Minot Automatic Rotary Microtome, which is perhaps the most common, will illustrate the general principles of all automatic microtomes. The paraffin block is pressed on a warm object disk and allowed to harden in place. The arm of the object disk is inserted in the clamp of the

microtome and fastened. A three-way clamp allows the block to be moved to any angle so that it may be cut perpendicular to its axis. The razor is held in a clamp below the block and is adjustable two ways in position and two ways in angle. On turning the crank handle through one revolution, the mechanism holding the specimen is drawn down across the razor and rises again; at the same time, a ratchet engages with a wheel and by means of a screw mechanism, pushes the object forward for another cut. By rotating the handle, a continuous band of paraffin, containing sections, may be drawn off. The ratchet may be set, by means of a cam, to cut sections of any thickness from 1 micron to 25 microns (.001 mm. to .025 mm.) The razor may be replaced by a special form holding Gillette safety razor blades which may be used once and thrown away. The object disk may be replaced by a screw clamp to hold the specimen.

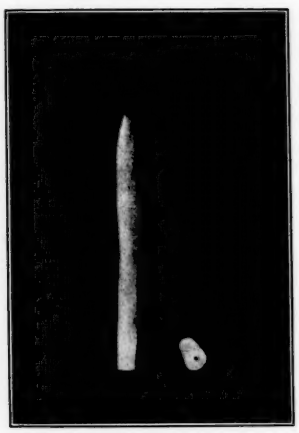

Figure 35. Candle for Cross-sectioning

A thorough knowledge of a complex instrument of this type may be obtained only by inspection and actual operation of the instrument.

Sections of 10 microns (.010 mm.) thickness are usually satisfactory in textile work.

Best results are obtained by leaving the paraffin block in the instrument for a while before cutting so that the paraffin and the razor blade are at about the same temperature.

Cross-Sections—Mounting

Glucose-gelatin sections are mounted in glycerine jelly, as described under longitudinal mounts.

Paraffin sections are transferred to slides on which has been smeared some albumen fixative (see Table IV for composition); the slides are held high over a Bunsen or alcohol flame until the albumen has hardened, which occurs at about the same temperature at which the paraffin melts. The paraffin is removed by flooding the slide with petroleum ether from a dropper, the mount is then rinsed with xylol, and a drop of Canada balsam and a cover glass added.

Cross-Sections—Quicker Methods

To imbed rapidly, a yarn is dipped alternately in melted paraffin and cold water until a candle of one-quarter to one-half inch diameter is built up. This candle may then be cut by hand.

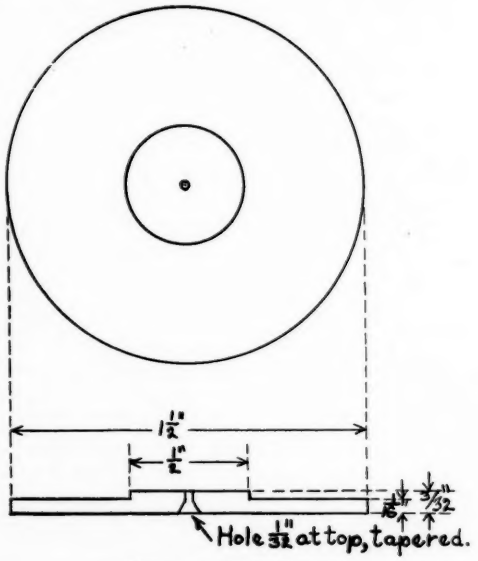

Figure 36. Rayon Condenser

When cross-sections are to be examined from several angles, they are mounted, by means of a drop Canada balsam on the point of a needle thrust through a cork, which in turn is cemented onto a slide. By rotating the needle the section may be turned to any angle desired.

A useful device for rapidly viewing cross-sections of any *white* fiber and which is particularly useful for rayons, is the so-called "rayon condenser." This consists of a brass disc of the size and construction shown in Figure 36. A loop of thread is pushed through the tapering hole from the top, a bundle of rayon filaments is inserted in the loop, which is then pulled through the hole, drawing the rayon filaments through and packing them tightly into place. If the filaments are cut flush with the top and bottom surfaces of the disc, and are examined by transmitted light, quite good results will be obtained on white or light-colored rayons.

(*To be continued*)

Ciba Color Card

Color card No. 715, entitled "Box Calf," has been recently issued by the Society of Chemical Industry in Basle. This contains sixty dyeings on chrome leather with direct and acid colors and dyeings topped with basic colors. Direct and acid dyestuffs are dyed in a pot for 40 minutes at 50-60° C. without further addition. Should it be necessary to overdye with basic colors, after 20 minutes the Gambier or Sumac is added to the bath containing the chrome leather color dyed further for 20-30 minutes and overdyed with the basic color in a fresh bath at 50-60° C.

Proceedings of the American Association of Textile Chemists and Colorists

The American Association of Textile Chemists and Colorists

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FIFTY-NINTH MEETING OF RESEARCH COMMITTEE—MAY 1, 1930

THE FIFTY-NINTH Meeting of the Research Committee of the American Association of Textile Chemists and Colorists was held at the Engineers' Club, Boston, Mass., May 1, 1930, 3:00 P. M.

The following were present:

L. A. Olney, *Chairman*
W. D. Appel
Wm. H. Cady
Hugh Christison
H. D. Clayton
H. R. Davies
Carl S. Draves
W. E. Hadley
Jos. F. X. Harold
H. W. Leitch
Wm. R. Moorhouse
Geo. A. Moran
W. C. Smith
W. S. Williams
P. J. Wood
Alex. Morrison, *Secretary.*

Mr. Cady, Chairman of Sub-Committee on Light Fastness, reported that a draft of letter to be sent to Dr. Paul Krais had been sent to the other members of the Committee for approval, but as yet it had not been returned.

The Chairman again discussed the personnel of the Rayon Sub-Committee, which as yet is without a Chairman. Possible problems for this Committee to work on were suggested and discussed.

C. L. Nutting briefly told of new developments in regard to preparation of samples for metal tests in connection with work by the Sub-Committee on Rubberized Fabrics. In connection with the work of this Sub-Committee, W. C. Smith, our Research Associate, told of his work on methods of analyzing fabric for the different metals which he has carried on at the Bureau of Standards and which he hopes to be able to continue in the near future.

Hugh Christison and W. C. Smith outlined work at present in connection with Fulling Tests in the Launderometer, and matter of standards was discussed in connection with these tests.

H. D. Clayton reported progress for the Sub-Committee on Shrinkage.

Wm. H. Cady had no special report for the Light Fastness Committee.

W. C. Smith as a member of the Sub-Committee on Bibliography reported on work of the Committee to be published in the next Year Book.

Wm. D. Appel, for the Sub-Committee on Standardization of Colors, reported the Committee was now working on a bibliography of this subject.

The Chairman asked for further suggestions of new ideas to be incorporated in the new Year Book and it was voted to put the dyestuff firms' initials after the color names in the list of "American-made dyes arranged by Colour Index Numbers."

It was also voted to use the same initials for firm names as are employed by the publishers of the Color Index.

The meeting adjourned at 5:15 P. M.

ALEX. MORRISON, *Secretary.*

APRIL MEETING OF THE RHODE ISLAND SECTION

THE April meeting of the Rhode Island Section of the American Association of Textile Chemists and Colorists was held on Friday evening, April 25th, at the rooms of the Providence Engineering Society.

The speaker, Dr. H. A. Lubs, gave a very interesting talk on "Chemical Control in the Manufacture and Application of Dyestuffs with Particular Reference to Indicator Test Papers."

Dr. Lubs is at the head of the Sulphur Color Division of the Jackson Laboratory of the E. I. Du Pont de Nemours & Company.

Twenty-five members were present.

A. NEWTON GRAVES, *Secretary.*

QUARTERLY MEETING OF SOUTH CENTRAL SECTION

THE quarterly meeting of the South Central Section of American Association of Textile Chemists and Colorists was held Saturday evening, April 26, at the Read House, Chattanooga, Tennessee, with an attendance of sixty.

During the course of the banquet, an entertainment consisting of songs and music was rendered, much to the pleasure of all, after which the meeting was called to order by the Chairman. The Secretary read the minutes of the previous meeting, and the Treasurer gave his report.

The following were elected members of the Sectional Committee:

L. L. Bamberger, Chairman, Cedartown, Georgia.

G. E. Frick, Flintstone, Georgia.

J. Remington, Everwear Hosiery Mills, Chattanooga, Tenn.

R. C. Staple, Box 483, Chattanooga, Tenn.

The Chairman appointed the following Membership Committee:

Ben. R. Dabbs
J. S. Neely
K. R. Straley
Dave Wallace
Tom Taylor

The meeting went on record as expressing their pleasure at having the National Association meet with them in December. A vote of thanks was extended the Entertainment Committee for the arrangement of the special program, and it was unanimously voted that this was the best meeting the Section has ever had.

L. R. HILLER, *Secretary.*

APRIL MEETING OF THE NORTHERN NEW ENGLAND SECTION

THE Northern New England Section met in Riverbank Court Hotel on Saturday evening, April 26. Twenty-nine members were present. Henry D. Grimes was elected representative on the committee to nominate officers for the national body. To nominate officers for the section a committee consisting of Harold W. Leitch, chairman, Hugh Christison, and Philip F. Ripley was appointed. It was voted that there be an outing, and to arrange it there was appointed a committee consisting of Frank L. McCool, chairman, Walter H. Zillessen, and John H. Grady.

The meeting was addressed by Henry F. Herrmann of General Dyestuff Corporation on "Formulae Men," and by Dr. Herbert A. Lubs of the DuPont Company on "Chemical Control in the Manufacture and Application of Dyestuffs with Particular Reference to Indicator Test Papers."

HAROLD C. CHAPIN, *Secretary.*

Chemical Control in the Manufacture and Application of Dyestuffs with Particular Reference to Indicator Test Papers

By HERBERT A. LUBS

Jackson Laboratory, E. I. DuPont de Nemours & Co.

IT IS indeed a pleasure to meet a group of men with whom my colleagues and I have so much in common. Though engaged in radically different work, we have a common interest. Your interest lies in obtaining dyestuffs of the best possible quality for a particular purpose and applying them in the most efficient and economic manner. Out interest lies in the production of dyestuffs to meet your most rigorous demands in unvarying quality and at the lowest possible cost, so that we may both benefit. Just as you have before you the application of dyestuffs to the ever-changing new textile materials with the consequent problems, so we have before us the constant demands for improvement in old dyestuffs to meet

new needs and the development of better and faster dyestuffs not only to satisfy those demands, but also the question of anticipating them.

To manufacture dyestuffs, regardless of yield and quality, is not especially difficult, but to produce thousands of tons of diverse dyes, some simple and some complex, in an efficient manner and of high quality, taxes the ingenuity of and requires the utmost of effort on the part of hundreds of the most highly trained chemists and engineers the country can produce. In developing a process suitable for plant scale operation it is necessary not only to determine most exactly the necessary specifications for the raw materials used but also to discover ways and means whereby the products formed in the intermediate steps can be analyzed and their purity determined. In addition, simple and easily applied control methods must be worked out so that a more or less skilled operator suffices to handle an intricate series of chemical reactions which ordinarily would require a highly trained chemist.

A case which recently came to my attention indicates in most marked fashion the importance of minute detail and the necessity of most exact control. For several years a certain dye had been manufactured with very satisfactory results in regard to yield and quality. Suddenly there was a tremendous decrease in yield and the dye obtained was poor in quality. A very prolonged and careful investigation was made of the nitrobenzol used in the process. It was found to be of high quality, in fact, somewhat better than that which was used when the process gave satisfactory results. Finally it was found that the nitrobenzol which gave satisfactory results was manufactured by means of nitric acid from Chili salt petre, while the nitrobenzol giving poor results was produced from synthetic nitric acid. This fact gave the clue which solved the riddle. The Chili salt petre nitric acids contained a trace of iodine which the other did not. By the addition of an extremely minute trace of iodine, to be exact, less than 1 part in a million to the nitrobenzol the yield and quality immediately became normal.

One of my good friends who is charged with the responsibility of manufacturing our most expensive anthraquinone vat dyestuffs, is inclined to look with disdain upon some of our cheaper though necessary dyes. In an effort to ruffle my usually calm and quiet disposition, he enjoys telling of his observation, somewhat imaginary, at a certain dye factory across the water in which they collect all refuse, chemical and otherwise, into one big pile. When the pile was sufficiently large it was mixed with sulfur and heated. Thus all their sulfur colors were produced. Perhaps such a process would produce a sulfur color similar to the old Cachou de Laval, but the days of Cachou de Laval are over. Nature can produce the beautiful rose of marvelous odor and wonderful hue from the lowly dung pile, but the chemist, lacking the incomparable skill of nature, needs the best and purest intermediates that can be commercially produced to manufacture a brilliant green or blue or bordeaux sulfur dyes. To produce certain yellow and brown sulfur colors requires a most rigorous control of conditions and the use of intermediates so pure that the most refined chemical methods are required to show the presence of any impurity whatsoever.

So far my remarks have been of a very general nature, but now I wish to be more specific and discuss briefly the desirability and means of determining the degree of acidity or alkalinity in both the manufacture and application of dyes. Numerous cases have been found in the synthesis of dyes and intermediates in which the degree of acidity or alkalinity at which the reactions are carried out is a factor of extreme importance if maximum yield and high quality are to be consistently obtained. In the application of dyestuffs there is no question but that this factor is also of great significance in many cases. I shall not attempt to specify patricular applications, but merely wish to point out to you some materials which we have found useful so that you can apply them to specific problems of interest to you which naturally suggest themselves.

The degree of acidity or alkalinity, usually called hydrogen ion concentration, is commonly determined either by means of the hydrogen electrode or by indicator solutions and colorimetric standards. The former method is of advantage when very precise results are necessary and when interfering substances are absent. It has, however, the disadvantage of requiring relative expensive and delicate equipment. The colorimetric method involving the use of standard indicator and buffer solutions has come into fairly extensive use in scientific and industrial laboratories as well as in plant operations.

Where the utmost precision is not required and where an exact determination of the actual hydrogen ion concentration is not necessary, a determination of the degree of acidity or alkalinity can be made very quickly and conveniently by means of indicator test papers. Unfortunately, however, there is no published information which describes a reasonably complete series of indicator test papers covering the ranges generally used. To-night I shall illustrate a series which has proved of great value in our work. Some of them are undoubtedly well known to you. With the others perhaps you are not so well acquainted. Those which we have found of most service are as follows:

Congo Red
Litmus (red and blue)
Brilliant Yellow
Phenolphthalein
Clayton Yellow

Others have been developed for certain special purposes but for general use the list given has been quite sufficient. They are arranged in the order of the increasing degree of alkalinity for which they are useful. In other words Congo Red is used in the acid zone and Clayton Yellow in the alkaline zone.

You have often seen statements to the effect that a reaction or operation was carried out in a medium acid to litmus or alkaline to phenolphthalein. Such statements do not give us a very true picture of the actual conditions used. If the conditions had been described as slightly acid to litmus but not to Congo Red or alkaline to phenolphthalein but not to Clayton Yellow, a much clearer idea would have been given. I wish to emphasize that the use of two overlapping indicators enables one to obtain a much more accurate control of acidity or alkalinity than is the case when only one is employed.

I have prepared a few solutions, commonly used materials, to illustrate to you the working ranges of this series and the colors produced. You will notice that the hundredth normal acetic acid decidedly reddens litmus but barely affects Congo Red, while N/1000 hydrochloric acid gives a decidedly blue change on Congo Red. One per cent sodium bicarbonate turns Red Litmus blue, Brilliant Yellow slightly red but does not affect either phenolphthalein or Clayton Yellow. One per cent sodium carbonate turns both Brilliant Yellow and phenolphthalein red while Clayton Yellow is not affected. N/1000 sodium hydroxide, however, suffices to give a decided red change to Clayton Yellow.

In conclusion, gentlemen, I wish to remark that the unusually keen competition, both foreign and domestic, which confronts all of us necessitates more than ever the utmost efficiency in our respective operations. Wherever possible we must know and not assume that our conditions are standard and uniform. The tools which I have exhibited to you have been useful to us in attaining this end, and I trust they may be of some service to you.

Discussion

Member: What is Clayton Yellow?

Mr. Lubs: Clayton Yellow is made from dehydro-thio-p-toluidine-sulfonic acid diazotized and coupled with itself. It is described in the Colour Index—No. 813.

Member: What is Brilliant Yellow?

Mr. Lubs: Brilliant Yellow is diamino-stilbene-disulfonic acid diazotized and coupled with phenol. It is described in Colour Index—No. 364.

Member: Is there a very wide range of these test papers available?

Mr. Lubs: Unfortunately, they cannot be purchased at the present time. For our purpose we make them ourselves. The dyestuffs used are commercial articles made either here or abroad.

Member: Is there any work being done by the manufacturers to establish pH values by means of hydrogen electrode?

Mr. Lubs: Efforts have been made to apply them to plant operations but as yet they have not found much practical use.

Member: Can these test papers be used for the determination of different stages of reaction?

Mr. Lubs: They give a rather rough control, but take the place of guesswork. They are particularly useful at hydroxyl ion concentrations somewhat higher than will be indicated by indicator solutions.

Mr. Pierce: Do I understand these test papers are used in the making of intermediates?

Mr. Lubs: Yes.

Mr. Pierce: In the finished products?

Mr. Lubs: Sometimes—yes.

Mr. Pierce: Is it not true that sulfur dyes vary more or less?

Mr. Lubs: None of them are definite chemical individuals. They are usually mixtures of a number of compounds.

Mr. Pierce: Polysulfides?

Mr. Lubs: Sulfur greens or blacks, for instance, are manufactured to arrive at a certain end-point, and by variation in the conditions of manufacture a change in shade and properties of their compounds is produced.

Mr. Pierce: Do these colors change under practical conditions?

Mr. Lubs: Many sulfur colors on the market will change upon storage. No general rule can be stated as to how and when these tests are applied.

Mr. Pierce: Is it not true that a color changes depending upon conditions of storage?

Mr. Lubs: In some cases it is true of Sulfur Black and many Sulfur Greens, but not in the case of sulfur colors in general. Cibanone Yellow, for instance, which is manufactured like a Sulfur Brown, does not change.

Mr. Pierce: In Cibanone colors you have a compound bound by a ring. I don't understand just how it stands. You say Cibanone Yellow will not change but is stable.

Mr. Lubs: There is no general rule as to the stability of sulfur colors. It all depends upon the starting material used for the production of the sulfur color and the manufacturing process used.

Mr. Pierce: When the sulfur colors leave the plant, have they passed a certain test of acidity or alkalinity? After they are out of the factory do you have the same degree of acidity or alkalinity?

Mr. Lubs: Often there is a decided change in the greens and blacks.

Mr. Pierce: Before the war a good deal of sulfur color sold in 1914 when people were buying colors, were re-sold in 1916 and 1917 when people were selling colors, but the colors had become acidified.

Mr. Lubs: Naturally, many sulfur colors will change because of oxidation. Certain ones show decided changes when exposed to air and moisture and lose much of their tinctorial value.

Proceedings of the American Association of Textile Chemists and Colorists

Formulae Men

By HENRY F. HERRMANN
General Dyestuff Corporation

IT GIVES me very much pleasure to be with you this evening, and I appreciate the honor accorded me by your Chairman in inviting me to address you. I confess that the prospect of facing the technical leaders in this country's foremost textile centre somewhat abashed me, and so I say, with sincere modesty, that I feel better qualified to listen and learn than to assume the role of lecturer.

May I suggest that you receive me as a fellow member of our Association, a guest from the New York Section, rather than as an official spokesman for the company with which I have the honor of being connected? If I touch on matters of a controversial nature, please accept my remarks as reflecting my own personal views—unknown, in any event, not discussed with my associates.

A few days ago I came upon a paragraph in a newspaper which I am going to read:

> "When a judge of the Supreme Court makes a mistake, it becomes a law; a doctor, he buries it; a preacher, nobody knows the difference; a plumber, he charges twice for it."

The dyer is in a somewhat less fortunate position. When he makes a mistake his customers do know the difference—he cannot bury the goods nor can he charge twice for the labor. In fact, he will probably have to cancel his bill and may have to stand the cost of at least part of the value of the goods which were spoiled. This leads into the subject of my discussion which is a contemplation of the causes of poor results in the converting of goods. Frequently poor results are due to reasons beyond the control of the dyer. Since dyeing is only one link in a long chain of operations which enter into the complete process of conversion, the dyer will of necessity feel the stresses and strains of these other links. Sometimes, however, the debasing factors are lurking in the shadows of the dye-house and it is with these that we are this evening especially concerned.

The title of my talk was given as "Formulae Men" and it awakened some discussion as to just what this meant. I will tell you where the idea originated. A statement was made at a recent meeting of the New York Section devoted to a discussion of industrial research, which I will quote:

> "I understand to-day all you gentlemen have to do, who are engaged in that field of activity, is to have certain formulae; that it is not necessary for a man to have technical experience, that anyone can apply the formulae. Therefore, the days of the old Chemist and colorist are gone. Naturally, it is going to be difficult to sell a research program to men, who simply apply formulae."

In my opinion, the value of research lies essentially in surveying the methods of olden and present days and then to progress from these to something new and original. Men who simply apply formulae—irrespective of results—won't be in business very long and we need not concern ourselves with this species. Men who apply formulae with discretion and with reasonable assurance of a successful outcome belong to a different class and we can with profit look further into their methods of working. Far from being hostile to research, these men probably more than any others, are alive to all the latest developments, and are properly classed as leaders in their trade. I will relate a few experiences to make my point clear.

About seven or eight years ago, one of the larger plush manufacturers in this country was confronted with a situation of high overhead and generally high production costs, that made competition extremely difficult and necessitated immediate attention. Working with the men in his own organization, asking for co-operation and making routine changes here and there brought no visible results. In discussing his troubles with a friend not connected with the concern and not himself a textile man, he awakened considerable interest in this problem. This man was a physicist, a mathematician, and above all a logical thinker. For convenience, I will refer to him as the "scientist" in my further remarks. The scientist asked for permission to spend a few days in the mill to observe the different departments at work, and in a general way to acquaint himself with conditions. All this was new to him, but being a resourceful thinker he was able to assimilate the various operations and to come to a fairly definite conclusion that many things were being done in a decidedly slipshod fashion. I will not endeavor to enter into any details on the improvements made in the weaving and finishing departments. My personal contact with the incident was limited to the dyehouse, and what was done there is typical of the results achieved throughout the plant.

The scientist discovered that goods sent to the dyehouse remained there, in process, practically the whole day and sometimes a second and third day. The number of seconds was out of all proportion and they showed a fair representation of all the major faults to be found in defective piece dyeing, namely, chafe marks, wild pile, streaks, and other forms of uneven dyeing, poor shade matches and different colors within the one lot. About that time plushes of guaranteed light fastness appeared on the market and in comparison with them this mill's output was woefully lacking in fastness.

The scientist had several heart-to-heart talks with the dyer, and found this gentleman adamant in his contention that the output per day of the dyehouse was all that could be expected and that the very best dyes available for this class of merchandise were being used. In short, plush could not be dyed any better. The scientist felt that he was not going to make much headway with this gentle-

man, and believing that some radical changes were necessary, he investigated the dyeing problem by consulting with successful dyers and chemists. He learned that it was not necessary for the dyer to have in current use over one hundred different dyes to produce the typical slates, browns and taupes most frequently called for. He was told that essentially only four dyes were required, but when he mentioned this to the dyer, he ridiculed the idea and absolutely refused to co-operate in any tests to demonstrate its practicability.

The scientist thereupon engaged a man for such trials, who had had some experience with cotton, but none with mohair—a man who had never done any dyeing, but was recommended as resourceful, honest and, above all, energetic. The two set to work on a small scale matching up some of the typical shades, using the four dyes which had been recommended. Having once established a formula for a given shade, they cut samples from different batches of plush and observed the application of this formula to them, and then ran down any deviations in results. It was found, that many preliminary operations required attention before they obtained a uniform quality of cloth, so that their formula, if carefully carried out, would always yield the correct shade. This preliminary investigation carried them to the raw stock, to the scouring, to the weaving, steaming and piece scouring of the material. When they thought that they were ready for the big tests, this amateur dyer was assigned one kettle at night. He was first given one piece, and after he had successfully demonstrated his ability to produce uniform results, the charge was increased to more pieces and eventually to the full capacity of the kettle. Obviously, some compensation was necessary for the varied conditions applying to handling lots of different sizes. This new man was very much fascinated with the results and asked for permission to take over a half dozen machines which he attended with one helper. The results were still excellent. Eventually, the scientist put this man in charge of the whole night shift. By this time he had worked out and stabilized sufficient formulae to make it possible for him to assume this responsibility. How successful he was is rather amusingly brought out by an incident which in its origin was intended to embarrass him.

The time clerk in checking over the cards found that this gentleman punched out at 10.30, at the latest a little after eleven, every night, instead of at 4:30 A. M. He reported this to the general manager, who called in the scientist and wanted to know what this serious breach of discipline meant. The scientist replied simply, that the dyer was through at 10:30 and that he did not think there was any need for him to sit around for five hours doing nothing. This of course started an official investigation, and when it was found that the work of the night shift was far better in every respect than that of the day shift, the manager decided to try the plan during the day shift which was cutting the labor of the night shift to less than half. This change revealed, that whereas only one set had previously been dyed per machine during the day shift, that by using scientifically controlled methods, one set could be dyed in the morning and another in the afternoon. Obviously, this doubled the output of the dyehouse and cut the overhead in half. It was also demonstrated, that it was perfectly feasible to dye three sets per day by utilizing the noon hours.

By increasing the efficiency of the dyehouse in this very striking manner, the operating costs were brought down, not only due to the saving of time and general overhead charges, but there was also a considerable economy in dyes and chemicals. Furthermore, the quality of the goods was infinitely improved, the colors were as fast as the best on the market and the matches were also very good. The number of seconds was reduced to an absolute minimum. So much attention was focussed on this matter of elimination of seconds, that whenever a poor piece turned up, a searching inquiry was made to determine the cause and to locate the responsibility. It now became a pleasure to walk thru the different departments of the mill, especially the dyehouse, and to note the evidences of discipline, of intelligent supervision, the mechanical aids, the temperature controls, etc., which made it possible to route the batches thru the necessary operations according to a set formula with an assurance of the expected result. And the drug room had not been overlooked. The inventory of dyes was reduced to a minimum, and the facilities for handling the dyes, weighing them, dissolving them and getting them to their destination were such as to eliminate errors.

It is, of course, understood that a system like this can function properly only if every link in the chain is intact. This means that the water supply had to be supervised and controlled, steam pressure maintained uniformly, the purchase of supplies supervised to assure quality and uniformity. Every department had to function according to set rules, and if a deviation from the set rule became necessary, the fact had to be reported so that precautions could be taken to eliminate the cause.

One might think, that such a transformation was unusual and could not possibly be duplicated elsewhere. Yet I have another story, which is equally interesting and also bears out the fact, that the application of elementary scientific rules can eliminate the "hit and miss" results in other mills. A large silk thread manufacturer with many plants scattered over the country realized, due to falling off of business and reduction in earnings amounting to an actual operating loss, that something was radically wrong. A new general manager was appointed, who conferred with the various plant managers, and time does not permit a review of the routine steps that were taken toward a complete revamping of the manufacturing personnel and methods. In the dyehouse they were con-

fronted with old-fashioned silk dyers, and as you may know, this school of dyers is accustomed to working by rule of thumb. Weights, percentages, thermometers mean nothing to them. In fact, one sometimes encounters silk dyers who have the greatest contempt for men who prefer to work with these tools now conceded by dyers in other trades to be essential.

The manager of one of these plants confessed to me, that it was not unusual for a batch of silk to remain in process in the dyehouse for a week and sometimes a week and a half. Prior to that time, color fastness had been no consideration. All that the dyer was asked to do was to match the shade, but the requirements as to matching were very exacting. It was now decided to improve the fastness of the colors, especially fastness to washing and ironing, and light where possible. The dyers seemed to be helpless in the face of this radical change. The most intelligent of them was called into the manager's office and was notified that he was under consideration for the position of head dyer in one of the larger plants which was to take over all of the dyeing previously scattered thru smaller units. The manager asked him a few questions such as:

Q. Do you think it possible to produce the shades we are regularly running with not over 30 dyes?

A. Yes.

Q. Do you think it possible to establish a formula for producing our stock shades?

A. Yes.

Q. Do you think that you could duplicate the results from lot to lot once you have established a formula?

A. The dyer hesitated, but answer "yes."

A few more questions of a similar nature were asked and satisfactorily answered, whereupon the dyer was notified that he was acceptable to the manager and was duly installed in office. A year later the manager in passing thru the dyehouse saw old John at work, and called him aside. He said: "John, it is a year now since you came here and we are very glad to tell you that we are very much pleased with the way you have taken hold of things. This is now our most efficient dyehouse and it looks as though we are going to make some real progress." John looked a little embarrassed and said: "Mr. Manager, I have a confession to make, something that has bothered me for a long time." "Well John, I do not know what's on your mind, let's have it." "Do you remember, Mr. Manager, a year ago when you asked me all those questions and I answered 'yes', and then you said I could have the job? Well, I said, 'yes' but in my mind I thought 'no', but I was afraid to say 'no' for fear I would not get the job. I have since found out, that I was wrong and that you were right. We are working along the lines that I promised you and the good results we are having are due entirely to working in this way."

Let me tell you just how they put this system into operation. The new dyer, willing as he was, could not possibly have re-matched all of the shades that he had to dye and it was essential that production be maintained without any interruption. It was decided to give the dyer a helper, and strangely enough the manager's choice fell on a man in the winding room, a young man who had never been in a dyehouse, knew nothing whatsoever about dyeing, and therefore had no prejudice or faulty ways to unlearn. He was neither a chemist nor in any other way qualified according to the usual standards, but he was a deserving young fellow, intelligent, thoughtful, resourceful and honest. It later developed, that he had an excellent eye for color and was gifted with a true dyer's intuition in the use of dyes. This young man was sent around to several dye manufacturers' service laboratories, and there became acquainted with the best products offered for the silk trade. He learned to dye these colors in simple shades. He then learned to combine colors and found out which worked together and which did not. He accumulated hundreds of samples; he made wash tests, ironing tests, sunlight tests and was shown the rudiments of tensile strength determination. After a few months of this sort of training, he went to work in the dyehouse; he was given a small kettle and a few pounds of silk and was permitted to work on the most prevalent stock shades, one at a time. As soon as he had developed a formula for one shade, it was transferred to the large equipment under the supervision of the dyer, but the young man was permitted to stand by and watch the evolution of his formula on a practical scale. Necessary changes were made, and eventually it was proven possible to duplicate lot after lot perfectly in the briefest possible time. The manager then found it safe to reduce his dyed stock to a minimum because he could depend on the dyehouse to dye rush orders the same day that they were received.

Gentlemen, you will all realize what this meant to the mill. It was now possible to stock only undyed yarn of the various constructions in regular use. The dyehouse could be depended on to supply any colors in quantities from 5 lbs. to 200 lbs. within a few hours. The other departments received the yarn in the best possible condition and were able to perform winding and spooling operations as quickly and as nicely as they could wish for. Here was a case where a man who had had no previous training was taught in a comparatively short time to do stunts that seasoned dyers considered impossible. Of course, this young man could not then and does not today have the responsibility for running the whole shop. On the other hand, the dyer does not have to concern himself with experiments. The two work together harmoniously and the results are as may be expected from co-operation of intelligent and competent men.

Other instances of a like character come to my mind, and undoubtedly most of you recall experience of a similar nature. There is just one more example that I might cite

and this time a large cotton mill is concerned. They operated with indifferent success a large continuous machine for the dyeing of sulphur khaki on cotton drill, after-treated with chrome and bluestone to meet the fastness requirements of better grades of workingmen's clothes. Their method, I suppose, was little different from general procedure elsewhere. It consisted of dissolving the desired colors in the feed tank connected with this machine and running a certain number of gallons into the dye compartment, diluting with about one-third of water. The material was then passed thru and fresh dye liquor fed to maintain a definite level. It stands to reason, that the first pieces coming thru were far from standard in color. The shade gradually changed until it reached a stable point and from that time on if other conditions were suitable a fair degree of uniformity could be expected. In sorting out a day's run of 30,000-40,000 yds., it is not unlikely when working in this manner, that the portion of pieces, off-color, was 10 to possibly 20 per cent. Unfortunately, there was a lack of uniformity among these off-pieces that necessitated storing the very sizable inventory of such goods until sufficient of any one shade was accumulated to make up a full case, which is necessary for their disposal. Many pieces were so badly off color, that they could not be sold and eventually were used either as leaders in the dyehouse or might be torn up into rags or sold as waste.

Naturally, this was a very expensive procedure. In this day of keen competition, of standardization, of low inventories and quick deliveries, any dyeing method that yields a high percentage of seconds is a double liability. It was a real pleasure for me to watch a skilled demonstrator take hold of this particular machine, start it up and run it producing the standard shade practically from the first yard to the last. There were a few minor variations in shade, due to changes in the cloth beyond the dyer's control, but 98 per cent of a 36,000 yd. run was packed out in case lots.

How this was done might at first seem very difficult, and was certainly puzzling to me, yet after a moment's reflection the underlying principle was so apparent that it became a simple matter to duplicate these results. It is an acknowledged fact that most dyes have their own peculiar exhausting factor. Very few exhaust sufficiently alike so that one can dye and feed a liquor of the same composition. By determining the exhausting factors of the various dyes used as applied in the particular machine under consideration and on the styles of cloth which are most frequently run, this complex problem is brought under complete control. There is nothing complicated about it; a simple table in the dyer's hands will give him the concentration per gallon of feeding color for any charge in the dyebox, that an experimental run on a new shade proves necessary. Within a reasonable tolerance, if a shade has been matched in the dyebox, and these percentages are applied to the feed liquor, the dyer is now ready to run and the shade will remain uniform. As in all other cases of this description, it is essential that the goods be prepared uniformly, that the speed of the machine be under proper control, that the washing compartments, squeeze rollers, etc., function properly. The compartments charged with chemicals used for after-treating should also be controlled and there does not seem to be any set rule to follow here. It is safest to work with a slight surplus of these chemicals and then to judge the strength of the liquor colorimetrically.

As I approach the close of this talk, I would like to add that to me personally, there is no finer sight than an organization, whether it be office or factory, in which all ages of men are represented. One naturally expects to see the older men, the gray heads, in positions of honor, carrying the responsibility which their years of experience and labor entitle them to. Then we have the middle-aged men whose lot it is to carry on the brunt of the day's heavy work. Last come the young men and boys, but I do not mean least. There is a place for these beginners in every establishment, and it is an unfortunate circumstance that sometimes finds these boys unappreciated, discouraged and eventually hardened into belligerent, disinterested, disgruntled men. I have seen wonders done with boys and young men. We need them to run our errands, and to do a million and one odd jobs for which older men cannot be spared. But let us not overlook the fact that nature has given youth enthusiasm, inquisitiveness and eagerness to learn and try new things for a very definite purpose. You can teach young men what middle-aged men are too busy to learn and elderly men too old to absorb or their interests are on other matters and cannot be concentrated on today's new developments.

It is an unfortunate organization which is run as a one-man proposition with only the dyer, or whoever else is in charge, knowing what is going on and everyone else kept more or less deliberately in ignorance. We, of course, all appreciate the fact that it is not wise to make public many things that happen in a mill, for the best interests of the concern. I do not refer to this sort of thing. I have in mind, knowing the how, why, wherefore and what of the details of the day's routine which is so frequently denied men in inferior positions. Picture a young man in a lowly position but with higher aspirations, possibly a high school training or a textile school course behind him, or in some instances, no special schooling, the boy just happens to be of the intelligent dynamic type, interested in what he is doing. He asks a question, and the only answer he gets is a snarl to mind his own business, and do what he is told! Not much encouragement there, is there? I have several times talked to boys and older helpers who knew of things that were running wrong,

who had the answer for certain conditions that gave rise to inferior results, but did not dare open their mouths about it for fear of losing their jobs.

I am of the opinion, and I think most of you who have stopped to think about it will agree with me, that learning is a mutual thing. We learn from those we teach, and in explaining matters we are forced to think and speak accurately, and cannot help but benefit. If a young man has a good idea, why not give him a few yards of cloth and tell him to try it out. Better yet, install a small sample kettle in your dyehouse and encourage its use for trials of this sort. I would not for a moment encourage miscellaneous, ill-considered, half-baked ideas, but there should be a place and a time and a routine for investigating the practicability of suggestions whether they originate with the boss dyer or the second-hand or the young chemist who is working in the plant. Anyone who has ever tried it will probably agree that the supervisor of a group of men working in this manner has no difficulty in keeping well in the lead of his group of helpers. Responsibility gives wisdom and he is apt to learn twice as much as the subordinate who conveys the suggestion.

I do not know whether it was a wit or a doctor who said: "To be successful, all of a man's glands should function properly, especially the sweat glands." I think you will all agree with me, that this applies especially in the dyehouse. It is my belief that there is more learning done in the steam and in the heat of the shop than there is in the cool comfort of the front office. It is the dyer's privilege, and I mean privilege, to watch the various pieces of apparatus in his charge. Competent men have told me that all they had to do to make sure that everything would run right. In the laboratory the boy who turns his skeins and looks into the dye liquor, becomes personally acquainted with the color he is dyeing. He knows what the powder looks like, he knows how it dissolves, he knows how the temperature influences the absorption of the color, he knows whether the color levels easily or with difficulty, he learns just how to feed the different chemicals which must be added to complete the dyeing job, then he watches the color either bleed or remain fast as he rinses the skeins. He watches the effect of hot drying, of cooling, of perspiration stains from the hands of other simple re-agents, he knows that color as few others, have the privilege of knowing it. When dyers know their wares as intimately as that, when they can instill in their organization an interest in the work that has to be done, with the reason why; if the organization is so disciplined and the equipment so scientifically supervised, that repetition of previously obtained results becomes practically possible, then, and only then, do I believe that they are ready to undertake dyeing by formula.

Discussion

Mr. Grady: You were going to tell us about the dyer's troubles, but it was all good news. You mention running a formula in a small lot and then in a larger way. You find the laboratory formulae are useful for dyehouse guides?

Mr. Herrmann: My experience has shown that a formula in the hands of the man who evolved it, whether it be a demonstrator or a mill man, is an extremely useful thing. It becomes necessary to adapt the formula to the particular mill's conditions. We were speaking of dyeing sulphur khaki in a continuous machine. I think you will all agree, that this is probably the most difficult thing to approximate in the laboratory of any problem that comes to my mind. Yet even this has been done with a fair degree of success. When a demonstrator is called upon to copy a given shade in a strange machine and is not permitted more than a few hours in which to do this work, and does not dare waste any material in unnecessary trials, he can fall back on fundamental laboratory formulae. He charges his dye beaker with the colors he considers appropriate and dips the material for the length of time which the practical machine will give. He then squeezes, airs slightly and after-treats. After the shade is approximately matched, one can roughly calculate the concentration of dye liquor required for one or more 500 yd. rolls, taking into consideration both concentration of color per gallon of dye liquor and also the ultimate relationship of quantity of color to quantity of cloth which the latter has established. The first practical trial may not come very close to the desired shade, but the experienced man accustomed to thinking in terms of percentage can adjust his formula so that the second trial piece will be quite close and the third or fourth acceptable.

I consider it quite ridiculous to expect a skein dyeing to yield a formula that can be applied to a job like this. One might as well after hearing a sonata beautifully played by a gifted virtuoso purchase the music on the way home, and confidently set it up on the piano and expect to play it. Why not? Here is the formula. That of course is ridiculous. If one's efforts do not reproduce the same result as was heard at Carnegie Hall it is not the fault of the piano or of the score and, certainly not, of the virtuoso; there may be something wrong with one's own talent. There are many musicians who play without music, but I would not go so far as to say, that they play better because they have no music. Is it not a fact that at some time or other, they learned what they are now playing from a score? The parallel applies to dyers. If they do not use a written formula they are drawing on previous experience and a latent formula exists in their mind whether they wish to call it that or not.

Mr. Grady: Then I would judge from your remarks that you only depend upon the laboratory for the percentage of colors to get a certain shade.

Mr. Herrmann: Yes.

Mr. Grady: In many cases the only thing they do get is shade, but the thing that interested me was the easy

manner in which the plush manufacturer got out of his trouble. Was it unevenness or cracky back or what?

Mr. Herrmann: Their trouble was that they could not copy their standard shades properly and I believe that this is a fundamental condition. We may assume that an experienced dyer knows what the correct colors are to yield the fastness which is required. There is so much technical literature available—and well informed dye salesmen, and demonstrators may be consulted so that no dyer need blunder on this score. Let us admit, for the sake of argument, that he is using the right colors. To me it seems that his chief problem is to get the colors on the cloth so as to obtain the correct shade. Is it not a fact, that in most dyehouses the early morning operations seemingly start off nicely enough. The men are experienced in loading the kettles, wetting the goods down, feeding on the color, adding Glauber Salt and acid, then bringing the temperature slowly to the boil and running at the boil for an hour. So far so good. Then the first sample goes to the dyer. It is hand scoured, dried and given a little cooling and finally inspected. How often is not the answer "4 ozs. of Red in machine No. 5" or "6 ozs. of Milling Yellow in machine No. 2", etc. It is here and now that the trouble starts. Usually the dye so carefully selected for its fastness and adaptability for the style of cloth being handled cannot be used for shading purposes; other so-called level dyeing colors must be used. Assuming that we are dyeing men's wear, these colors must be of the faster sort, and it is difficult to distribute an ounce or four ounces of fast color over a kettle of goods in the time usually allotted for this purpose without getting shady pieces.

It may be that several additions are necessary before the dyer finally passes the goods; then they go to the finisher and he may scour off that last touch of red that the dyer so carefully put on. In the decatizing some other color may run, in the sheering all of the superficial color is nicely removed and when the pieces finally reach the perch, they are seconds anyway, but they are not as good seconds as they might have been in the first place when they only lacked a touch of red. They are probably still off-color but in addition they are shady, the backs may be heavy, the centers may be light, and they may be an inch too narrow. The silk stripes probably have not benefited from the long boiling and in every possible respect the goods show that they have been worked too long. Therefore, my idea is that any device or scheme or method which will help you to get the desired shade in the first dyeing will largely overcome all of the trials associated with cobbling, topping off, re-dyeing and the like. If a certain shade is a persistent trouble maker, there is probably something wrong with your method of dyeing it. Here is where your little sample kettle would come in so handy, and your young man, who knows the general dyehouse routine, can be entrusted with a little job like this without taking the boss from his regular work.

Mr. Cady: Suppose the dyer that had such good results at the plush mill had had the job of dyeing a miscellaneous collection of shades on cotton skein yarn with vat colors, say four vat colors.

Mr. Herrmann: In that same dyehouse vat colors are being dyed; they also handle direct colors, developed colors, Sulphur colors and Naphtols. Every bit of this dyeing is under careful control. The man in charge of some of the yarn dyeing creates the impression when one first meets him, of being just the ordinary run of dyer and I am quite sure that he has had no special training either in chemistry or in physics, but has apparently learned his lesson well, because he has little or no difficulty in duplicating shades accurately and quickly. As I mentioned before, they also handle Naphtols which were formerly dyed in the skein and were then used for filling. Considerable trouble was experienced, due to lack of uniformity resulting in barre effects, in the backs of the plush. It was decided to dye the Naphtols in a continuous warp machine, for the sake both of economy and uniformity. Experience soon showed that the feeding problem in naphtolating the yarn required the very nicest attention. The usual precautions were taken, namely, maintaining the level of the Naphtol liquor at a certain mark, but on some days the color of the warp would taper off to the light side and on the next the reverse might happen and the color would gradually become stronger. If the two warps which were eventually used for filling were mixed, the material presented a very streaky appearance. In any event, the results were not always passable. As I mentioned before, the personnel in this mill had become rather accustomed to using their wits in running down elusive problems and it was discovered that the atmospheric humidity was responsible for this condition. In moist weather, the warps would not absorb as much Naphtol and the shade would gradually lighten. In very dry weather the reverse occurs. Having established the effect of humidity several remedies suggested themselves, and as far as I know this feature has ceased to be a problem in this mill.

Some problems are possible of solution and others are not. Colors that oxidize slowly in the air such as sulphur colors, may cause insurmountable difficulty in producing exact color matches. A generous tolerance must be exercised in passing on such work. All we can hope to achieve by careful attention to detail when working with these more elusive problems is to obtain uniform results. If every batch of yarn changes the same way as it ages, one may concede that the dyer has done the best that is possible under the circumstances.

The silk dyer whom I spoke of earlier this evening was confronted with all of the trials of the small lot dyer. Seldom could he choose the size of the lot which he had

to dye and, therefore, his formula had to be interpreted intelligently so as to apply to these varying conditions. Actual experience has proven, at least in this case, that by giving the dyer silk which was processed during preceding operations with the most careful possible control, that the dyer had little if any difficulty in checking his results. I appreciate the fact that vat dyeing involves variables which are sometimes very difficult to control in such a way as to preclude the possibility of shade variation. I would not, however, for this reason omit one iota of attention to every detail which is in my power to control. By working in this manner it is not unlikely that one may be surprised to see that shades develop very satisfactorily. I do not advocate any man following a formula so slavishly that he pursues his mapped-out course irrespective of unique conditions that render this procedure incorrect in some particular instance. Here again I recall what I said previously about knowing your colors, of becoming personally acquainted with their peculiarities. If the man in charge of vat dyeing operation notices that his vat is not developing as it should, then he should go no further until an investigation has been made as to the cause. Such a course is self-evident and I mention it only to explain that my suggestion of a formula does not mean a blind following of instructions irrespective of the results.

Mr. Durfee: There is a belief around to-day that anything may be possible. I think this belief must be eliminated. In the colleges about which we hear so much it is taught in the mathematical departments that some problems are impossible to solve. If you have a number of requirements to be satisfied and a number of things which you could adjust or arrange so as to meet the requirements, then you can have your problems made impossible if the number of requirements is too large in comparison with the number of arrangements which you can make meeting the requirements.

In many mills the requirements seem to be that about 95 per cent of our work must be a copy of what somebody else has done with machinery that we do not have and dyes that we do not use. Frequently there is not enough leisure or time allowed in advance for making the careful adjustments of chemical processes which are necessary for success.

The only remedy which I can see is to make our problems possible by modifying the requirements which are to be met; less copying, more original shades, more leisurely timed if possible, and more leniency in copying shades. If a shade is made with seven colors it may not be so easy to copy it exactly with four.

A wise selection of requirements is up to the management. The management described in to-night's lecture should be congratulated.

Member: Do you think that more can be done with young men working under supervision?

Mr. Herrmann: A young man working on a sample kettle should carry out his work on a small scale following the general procedure which he knows to be correct for large scale dyeing. If he does this, then his results can be copied on a large scale.

Mr. Durfee: I think a young man is a very wonderful help. He is usually inexperienced but he can usually stay continuously with his work. It usually takes a long time to establish one chemical manufacturing process well and if the young man can be spared to stay with it under a little guidance, it works out wonderfully.

Mr. Herrmann: In most mills there are certain fundamental problems which can be considered individually, and over a period of years an answer can be found for each without at any one time causing undue work or confusion. If we consider a woolen mill dyeing men's wear, there are certain typical problems that can be studied one at a time. For instance, what is the best way of dyeing blue serges? As far as I know, each mill has its own method. There are certain similarities between them, but enough difference to raise the question of which is the best. Or we may take fancy goods with silk stripes and we can study very advantageously the best method of dyeing navy blue leaving the silk stripes in best condition. Much has been written on this subject, and I frankly admit that some of the old formulae are quite hopeless. Attention can be given to black either in solid shades or fancy; then a general survey of browns, and grays. Having covered this ground there are few fundamentally new color problems left. If we use colors and a dyeing method that will penetrate the tightest weave, it will work very satisfactorily on looser weaves. If we have a method that will leave white silk clean, it will work very well on colored silks. By reducing the problem to a few fundamentals and by using the selected dyes over and over again for the many seasonal shade variations that develop, the dyer can concentrate his attention on the matching problem, and if he uses his little kettle to good advantage, he can dye his sample pieces in such a manner that they can afterwards be copied with a single dyeing without having recourse to topping.

In cotton mills there are also certain bread and butter jobs. There are black warps, and blue warps and red warps. There are sulphur khakis and all the other typical problems that repeat day after day. One cannot tackle them all at once, but I strongly advocate taking each one in turn and revising and revamping the current method of producing these effects so as to get the lowest costs commensurate with the desired quality, having in mind, of course, the ability to duplicate the results from lot to lot so as to eliminate seconds.

Sometimes it appears that one must be truly pedantic in one's attention to details, but I am positive that in many instances it is this attention to detail which determines the success of the job. You will recall what I said about

watching the exhaust liquor in your kettles. If you happen to be dyeing a common top chrome navy, it is quite necessary to observe the quantity of unexhausted dye left in the liquor when the time comes to add your chrome. It is quite obvious that any blue left in the liquor, and almost always there is some, will continue to dye on the material by the chromate process. In other words, the bulk of the color is top-chromed, but an uncontrolled residue is dyed chromate. The former yields a nice navy, but the latter a dull slate. By not controlling this feature the finished shade differs from standards, and the dyer is forced to brighten or sadden the color by subsequent additions which make his work harder and detract from the quality of the goods. Since even the kettle hand must contribute to our scheme of scientific dyeing, it will be necessary to scientize his work and to train him to do it well.

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The lapel button badge illustrated herewith is worn by members of the American Association of Textile Chemists and Colorists.

The three "rings" are enameled in red, yellow and blue, respectively, and the initials and border are brought out in gold. The general effect is exceedingly attractive.

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Dyeing and Finishing Rayon Upholstery for Automobiles—II

By **FRED. GROVE-PALMER, A.I.C.**

(*Continued from issue of May 26, 1930*)

BASING his ideas on the dyeing instructions in Part I of this article, the dyer will find little difficulty in producing two-color effects by means of two separate baths. If he omits the acid and makes up the substantive dyebath with dry sodium carbonate (1 per cent) the viscose rayon can be dyed readily enough. After lifting and rinsing the batch thoroughly, it is run into the acid or wool dye solution which, as previously stated, has an acid reaction at the end. For dyeing under these circumstances practically all the various sorts of dyes are suitable, and there would be no point in mentioning a few where all, or nearly all, are so good.

Because of the value of the materials undergoing treatment all the practical technique of the dyehouse should be carried out with scrupulous care. The solution of the dyestuff, for instance, should be complete, no specks of undissolved coloring matter being permitted to pass into the liquor. If the powder is stirred up with a small volume of hot, but not boiling water, it will readily dissolve; it is then passed through a fine muslin or wire sieve. Any particles of solid color left on the sieve can then be rinsed off with boiling water, the solution being added to the bulk. This method is the one usually followed in busy dyehouses because it is quicker and less apt to cause the dyestuff to ball up; when this occurs it often takes a long time to get it completely into solution.

The relation between time of dyeing and the temperature of the bath is exceedingly important; while the first is to be as short as possible the second should be kept low. As these conditions are more or less contradictory, it is up to the dyer with experience so to arrange matters that he is working under the optimum conditions for getting the desired results.

The stability of the color to the influence of light may be considerably augmented by diazotizing and development of suitable dyes. The goods having been dyed, are well rinsed and then passed into the diazotizing bath, cold, for about twenty minutes. This bath may be, as follows:

Sodium nitrite	2-3%
Hydrochloric acid (S.G. 1.160)	5-7½%
or Sulphuric acid (S.G. 1.840)	3-5%

During the period the material is in contact with this liquor it is very necessary that it should be shaded from the direct rays of the sun, otherwise objectionable brownish stains will be produced in the finished goods which are very difficult to get rid of. At the end of the prescribed time, the goods are lifted and washed well, and are next passed into the cold developing bath where they are worked for a similar period. This bath consists of either of the following:

1. 5% Beta-oxy-naphthoic acid with half its weight of dry sodium carbonate dissolved in 10 times its weight of water. This is poured into the bath and sufficient formic acid added to produce a slightly acid reaction.
2. 0.75% Phenylene Diamine dissolved in half its weight of soda as above and dissolved in a similar quantity of boiling water.
3. 1% Resorcine dissolved by adding an equal weight of strong caustic soda lye (S.G. 1.375) and boiling in 10 times the weight of water.
4. 1% Beta-Naphthol dissolved in the same way.

There are on the market a number of developers under proprietory names, each of which has it merits and which, like those given above, should be chosen for the production of a specific result, it being understood that any of these will yield a shade differing, in many cases, very considerably from that produced by the others.

The goods will require a very good washing on lifting from the developer.

It might be commented that the introduction of sulphuric acid in the diazotizing bath is against the principles of good dyehouse practice for silk and rayon at the present time. In days gone by sulphuric acid was very largely used by silk dyers until it was proven that much of the deterioration and tendering that occurred during storage was undoubtedly due to the presence of minute traces of the acid that could not be washed out. For this reason whenever an acid is to be used in a process not to be following by neutralization, the acid should be either formic or acetic, the first being preferable; these are volatile and pass off eventually without damage to the fiber. It will be seen that the mineral acid used in the diazotizing bath is always neutralized at a later stage of the proceedings.

With regard to the choice of substantive dyes for use on viscose, it is worth while mentioning that it has been found, by one of the biggest firms of viscose dyers in the world, that the fact of a dye giving good results on cotton does not necessarily imply that similar excellence will follow its use on viscose.

A matter of this kind should be investigated whenever a fresh dyestuff is brought in unless the suppliers can afford direct evidence as to its suitability. There are good cotton colors which are no practical use at all with rayon. The whole subject of the substantive colors has been very closely studied by the research departments of the manufacturers and of the dyers, and though the greater part of the observations have been made with regard to their use on cotton, during the past eight or ten years increasing work has been carried out in the interests of the rayon users. The consequence of all this has been the introduction of an almost unlimited range of beautiful shades of exceedingly high quality.

There is no doubt that the most satisfactory of the different classes of coloring matters are the vat dyes though they suffer not only from their high cost but also from the comparative difficulty of using them. The question of expense is not one that should weigh very heavily in consideration of the excellence of the production; the material they are used on, in this case, is not a cheap one and the difference in the price of the dyes used cannot make more than a few cents per yard addition to the selling price. In view of the fixity of the colors to light any extra trouble involved in the manipulation is well worth taking.

The working instructions supplied by the manufacturers will be found sufficiently detailed, in most cases, if the dyer is not already familiar with the use of these dyes, and when experience has been gained it is easy enough to modify these to suit local conditions. The following method is one which has been so modified and has been very successful in practice especially in assisting in leveling the color, which sometimes is rather difficult.

A load of 100 lbs. of the fabric will require a bath of 480 gallons of dye liquor. About 450 gallons of water, softened, is raised to between 45 and 50 deg. C. and to it is added 4½ pints of caustic soda lye (S.G.I. 380) and ½ lb. of hydrosulphite powder, concentrated. The reason for making this preliminary addition is to neutralize any oxidizing action that the air dissolved in the water might have upon the reduced dyestuff that is to be put in later. This may seem like splitting hairs but everything in vat dyeing depends upon the standardization of the method, without which regularity of shade cannot be produced. The dye solution is made in a wooden or pot vessel; this should be fitted with a lid in which there is a hole; a stick is put through the hole for stirring, thus keeping air from the contents. The following quantities are wanted for a batch of the size mentioned:

Dye paste	20 lbs.
Caustic soda lye (as before).....	2¼ gallons
Hydrosulphite	7 lbs.
Marseilles soap	4½ lbs.
Fish glue (for pale shades only)..	3 lbs.
Water, softened	36 gallons

The soap and the fish glue, if used, are dissolved in a small quantity of the water before adding them to the other ingredients. The water is warmed to 60 deg. and the whole should be stirred for fifteen minutes to finish the reduction of the color paste to the colorless leuco-compound. One-third of this quantity is added to the vat which should be thoroughly stirred and then permitted to stand for ten minutes to allow of a complete equalizing and also to give time for any scum that may arise to be removed with a skimmer. The vat is now ready for entering the batch which should be done as rapidly as possible so as to prevent ending, that is: producing a deeper color on the first end of the rope to go in the liquor, due to the dye rushing on. Once the whole batch is in, the rate of work may be slowed down for ten minutes, after which the remainder of the dye liquor may be put in, a small quantity at a time, and the working continued for about thirty minutes longer until the dyeing is completed. The batch is now raised and allowed to drain for a few minutes before being plunged in a bath of cold water. It is then oxidized by opening it out and letting it hang in the air.

The right time to stop is learned from swatches taken at intervals when experience shows that the dyeing may be expected to have reached the desired tint. The dye liquor should be completely exhausted and in practice is allowed to run to waste; it is doubtful if it would ever pay to try to recover the contents.

Exposure to the air for oxidizing usually occupies about an hour but there are methods of hastening this should occasion arise. One such method is to run the goods through a weak bath (S.G. 1.00025) of Eau de Javelle, sodium hypochlorite, or a bath containing one-eighth of one per cent of sodium peroxide. This takes a few minutes only and does the work perfectly, the only point to be remembered is that not all the vat dyes are fast to chlorine and, therefore, the hypochlorite should only be used on those that are. A soap wash follows the re-oxidization of the color; this is heated to 80 deg. and is made by dissolving 1½ lbs. of Marseilles soap in 120 gallons of soft water. After receiving two warm water rinsings, the goods are passed through an acid scrooping bath and dried for service.

Some dyers hold that scrooping is not wanted on fabrics for auto interiors; they use the acid bath simply for the purpose of neutralizing the alkaline that remains even after the rinsing, and put the bath at the end in order to get a softness of hand. The position of these two baths in the sequence of the process is decided by the nature of the fabric.

The greater number of the vat dyes are obtained in the form of pastes, but there are some sold as powders; this does not make any appreciable difference in the mode of using them. In the various manufacturers' lists will be found certain small modifications which apply to special

colors; note should always be taken of these because any deviation from them may affect the tone of the finished material. Among the vat dyestuffs that are suited to this work will be found the following:

Ponsol Yellow G. dbl. pdr.
" Golden Orange R
" Red AFF
" Violet RR dbl. pdr.
" Blue GD dbl. pdr.
" Brilliant Blue R
" Brilliant Green G
" Black B conc.
Duranthrene Yellow G extra
" Golden Orange 2RT
" Red BN
" Brilliant Violet R
" Blue GCB
" Olive R
" Brown B
Caledon Yellow C
" Gold Orange
" Brilliant Violet 5B
" Blue RC
" Olive B
Indanthrene Red RK
Cibanone Brilliant Violet R
" Blue 3G
" Olive B

The experienced vat dyer will have noted that the bath given here is decidedly on the long side; the reason for is that viscose has a far greater affinity for vat colors than cotton and, therefore, the ordinary concentration of liquor would be far more difficult to work. There is also a noticeable reduction in the quantity of alkali that is used for the reduction of the dye to the leuco condition; this is because both the fibers under discussion are adversely affected by strong alkalis and this means is taken, together with the inclusion of fish glue for pale shades, to lessen the ill effects as well as to prevent the color from rushing on too rapidly. The soap, too, acts by way of a buffer. Temperature here, also, should be kept down; with some of the dyes it is permissible to work in the cold.

The final soaping of the fabric has an additional value in that it proves whether the whole process has been properly carried out or not, and though this information arrives too late to be of any material use to the batch that has just come through, it may tell how to improve on the next if all has not gone well. Consequently, if the dye is found to soap off during this last bath or if dyestuff is found precipitated at the bottom of the back, the dyer will not fail to realize that all has not been going as it should and he must look to it that these mistakes are not repeated in subsequent batches.

Brocaded fabrics from the jacquard looms are not dyed in the piece, in all cases; many are woven from yarns dyed in the skein. The improved makes of viscose have caused a large increase in the designs for this type of material, there being no longer that harshness and crudity of outline seen in the figure that was an unpleasant feature of the earlier brocades.

Hank dyeing of viscose for the purpose above indicated does not involve so much difficulty as the foregoing, the method generally being used in coloring with the substantive dyes. The usual temperature of the bath for mid and dark shades is between 90 and 95 deg. C., letting it run as much below that as possible in the case of the paler tints. The liquor is charged with from 10 to 20 per cent of Glauber's according to the depth of shade; there are many dyes for which this addition is not necessary, a point that should be ascertained from the supplier or the manufacturer.

In those fabrics which are composed of rayon with either of the vegetable fibers: cotton, fiberflax, jute, ramie, and the rest, cross-dyeing is not a commercial proposition. One hesitates to say it is impossible but it certainly would be exceedingly difficult to perform on a work's scale. Such dyeing is always carried out in the hanks and then passing to the weaving mill. The affinity for the colors of both the native and regenerated cellulose found in both classes of fiber is, of course, the reason for the difficulty. The previously mentioned fact concerning the suitability of certain for rayon being different to that of cotton, is equally important here, of course. It may be advantageous to list a few examples of the dyestuffs that have been especially chosen for the good effects they produce with viscose from the pattern books of domestic dye makers:

Thioflavine S
Pontamine Fast Orange EG
" Brown CR
" Purpurine 10B
" Scarlet B
" Brilliant Violet B
" Blue RW
" Green GB
" Fast Gray B
" Black RX
National Erie Fast Yellow Y
" " Fast Orange 4BA
" " Red 4B
" " Cardinal 7B
" " Fast Brown 3RB
" " Violet 3R
" Niagara Sky Blue
" Niagara Blue G conc.
" Erie Blue Green CW
" " Fast Gray M
" " Black RF

For exceptional fastness to light there is the latter firm's range of Solantine dyes which includes the following:

Yellow 4GL, FF
Orange G
Brown R
Red 8BLN
Pink 4BL
Violet R

Blue 2GL, 4GL, FF
Black L

There is also a short range of reds issued by the Du Pont people having two Naphthanil reds worked on three Scarlet bases thus producing some variety in shade. These come under the diazotizing and developing heading but require special formulae, details of which may be obtained from the makers.

An additional reason for making use of predyed yarns in the heavier cloths required for upholstering autos is that they call for less handling during the finishing processes and, therefore, reduce the risk of damaging the cloths to a minimum.

Manufacturers of this type of material who are not already introducing rayon into the automobile decorations will do well to keep an eye upon this increasingly popular trend of taste; there is little doubt that the near future will see a still further extended employment of these beautiful fabrics which has already gotten a firm footing in the higher class trade.

The Chemist's Place in the Department Store

By M. C. Dearing

SLOWLY, but very surely, the leading department stores in the larger cities are finding it desirable and feasible to incorporate a chemist into their organization. Mainly, even in these days since the war, which introduced to the world at large the capacity for construction which the chemist has, the chemist is conceived (when thought of at all by store department managers), as one who analyzes, may determine the construction of a fabric, the nature and suitability of a fabric, material or dye, determine wool and silk percentage, certain laundering qualities; certainly not one who can advise on merchandising dependability of sources of supply or factors of publicity.

Go into three or four leading stores, ask the manager if he employs a chemist; if he thinks he could use one. Probably not one in four will offer a broad discussion, but will reply as above indicated—that he has little need of a chemist, and when he has, sends his request for a determination of some fabric value to a consulting laboratory.

Without offering a discussion, it is my purpose only to suggest wherein a chemist may function as a department store executive. The following list may be entitled:

Qualifications Desirable for a Department Store Chemist

1. He should have some practical technical and executive mill knowledge of fabric construction and processing.

2. Be able to make a mill survey and report accurately on its dependability to produce and to maintain a consistent quality of product at a consistent price.

3. Be able to examine and analyze garment construction, fabric construction and constitution, determine dye types in the dyed fabrics; immunity of these garments, fabrics and dyes to particular damage or deterioration; general weaknesses and inconsistencies; and of other merchandise similarly.

4. Be able to assist in purchase of maintenance supplies by advising market sources of commodities regardless of trade or arbitrary names of products.

5. To apply information in a manner suggestive of constructive ideas to the advertising department.

6. To originate suitably pertinent, concrete, as well as abstract publicity, which will suggest real or fancied superiority to the public.

7. To establish for middle class trade an *indicated ratio value* between similar standardized lines of merchandise, whereby lines selected may be maintained always available to purchase, with reference to domestic replacement supplies, using, perhaps, linens as a beginning, selling on a basis of these standards, rather than on brand names, thus establishing dependable standards as a basis of store confidence in the mind of the public.

8. To render practical laundering information concerning some items.

9. Essentially to establish for the store a distinctive service beyond that of other stores, partly actual and perhaps partly psychological, by means available to a chemist.

10. To establish and operate a real but intentionally impressive laboratory in the store at some strategic point to be viewed and to an extent its working elucidated to the curious and impressionable patrons.

11. To aid in the clerk-educational service.

12. To prepare short articles of a nature consistent with public interest to be printed in what may be the weekly "chemist's corner" of a regular store advertisement.

Rayon May Be Made from Gas and Water

At a recent meeting of the Canadian Chemical Society, Dr. Harold Hibbert, Professor of Industrial and Cellulose Chemistry at McGill University, pointed out that at some future time it might be possible to manufacture cotton, wood and rayon from carbon dioxide.

Dr. E. C. C. Bailey of Liverpool University has already made sugar by mixing carbon dioxide and water.

Dr. Hibbert explained that sugar from plant life could be converted into cellulose, which is the chief constituent of cotton, wood, paper and rayon. It is, therefore, possible in the laboratory at the present time to produce these products synthetically from carbon dioxide and water, largely through the application of ultra violet radiation. It remains, therefore, only to work out a practical industrial process in order to commercially take advantage of these recent discoveries.

The plant of the Pearless Color Co. at Plainfield, New Jersey, has been recently equipped throughout with a Grinnell sprinkler system.

AMERICAN DYESTUFF REPORTER

Devoted to the use and application of dyestuffs and the mechanical equipment incidental thereto.

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It is with deep sorrow that we report the death on May 29th of Edith Sprague Predmore, Secretary of Howes Publishing Company since its incorporation in 1918. Miss Predmore, who in private life was Mrs. Arthur Defonis, succumbed to an attack of pneumonia at her late residence at Long Beach, N. Y.

Miss Predmore was one of those rare individuals whose devotion to the interests of those they serve transcends every personal consideration. Her loss to the company will be irreparable, and her many friends throughout the Textile Industry will join with us in extending the deepest sympathy to those of her family who survive her.

THE TEXTILE ALLIANCE FUND

WITHIN the past week there have been two notable developments in regard to the Textile Alliance fund about which so much discussion has revolved. The United States Senate, after having received a favorable report from its Committee on the Judiciary, has passed the so-called Merritt Bill (H. R. 9557), previously passed by the House of Representatives, and Justice Frank J. Coleman of the United States District Court has handed down a decision relating to the funds that had been accumulated by the Textile Alliance, Inc.

The Textile Alliance was incorporated as an organization without purpose of profit in 1914. Its aim was the protection of mill owners and operators, and the prevention or reform of abuses, unjust and unlawful exactions, deceptions and frauds in the manufacture and sale of mill supplies. One of its first arrangements was with the British Government whereby wool might be imported into this country from Great Britain at a time when the shortage here was particularly acute. The Alliance took the consignments and guaranteed that the shipments would not be exported to, or for the benefit of, Great Britain's enemies. This arrangement worked satisfactorily; in effect it continued after our entrance into the conflict and until the end of the war when the Textile Alliance returned to its members funds accumulated over and above expenses.

In the latter part of 1919, the Department of State indicated that American consumers were finding difficulty in obtaining dyes that had been impounded in Germany by the Reparations Commission. Through an exchange of letters, the Textile Alliance and the State Department arranged an agreement that the Alliance would clear these dyes in about the same way as had been done previously with the wool, except that the Textile Alliance in this case was obliged to buy the dyes outright, obtain pay for them from customers, and then finally make financial settlement with the Reparations Commission.

The Alliance secured the underwriting of orders for the needed dyes by responsible individuals and firms so that the shipments were completed to New York on bills of lading, being paid for in cash when they arrived.

Under the agreement reached in 1920 between the State Department and the Alliance calling for the importation of the dyes, the profits realized were to be divided, going partly to the Alliance and partly to the Government. The profits amounting to twenty-five per cent accruing to the Alliance were to be distributed in the interest of science to such institutions as the Alliance might designate; the remaining seventy-five per cent apportioned to the Government was to be expended for a like purpose.

All of this seemed plain enough, but to make the assurance doubly sure and to give full legal support to the agreement between the Textile Alliance and the Government through the Department of State, a friendly suit was instituted. It is this suit which has just been decided by Justice Coleman. As a result of the decision, Princeton University receives from the Alliance's profits the sum of $124,253, to be applied to the university's endowment fund for research in pure science; the Massachusetts Institute of Technology receives approximately $28,000, and the Philadelphia Textile School approximately $248,000.

This suit, brought to determine the accounting of the profits, tends moreover to clear the handling of the balance of the funds, such part as remains to the Alliance being held for a period and then distributed for scientific research. The larger proportion of the profits goes, of course, to the Government, the arrangement being that it shall be disposed of as Congress directs. It is here that the Merritt Bill comes in.

The measure which is now before the President for his signature provides that there shall be established the Textile Foundation, a corporation which will be authorized to receive directly from the Textile Alliance the funds to be turned over to the Government. The corporation is to have a board of directors composed of the Secretary of Commerce, the Secretary of Agriculture, and three other individuals familiar with the textile industry or its allied fields to be appointed by the President. The board will

be given full power to administer and expend its funds in accordance with the objects set forth.

It is to be hoped that there may be a close association between this board and the newly-organized United States Institute for Textile Research, and that there may be all necessary and desirable co-operation toward the common goal of research to the benefit of every interest in the textile field. The attainment of such an object, it may be at once admitted, will not be easy. With the best will in the world, governmental projects sometimes are slow in development and, at the same time, are subject to influences which may or may not result favorably to the industry directly affected. It is a cause for congratulation that the textile industry itself is in a position to indicate practical methods of accomplishing the desired ends, and its voice, after due consideration has been given the important matters involved, should have special weight.

Random Thoughts On Research

Foreign Research Associations and Their Lessons

THE work of foreign research associations, particularly those in England, during the last few years has been very interesting, and we are very grateful for the privilege of reading the published material that has been released. We have the impression that these associations have been highly successful. We understand that they are generally considered successful in England, but they have been sharply criticized for lack of results, particularly practical results.

It has been a struggle to get sufficient funds and in nearly a decade of existence there seem to be but few discoveries that are at all revolutionary and these are still in the development stages so that their true value can hardly be assessed.

We should learn something from the fact that as subscriptions are paid year after year, there is a natural demand for some sort of immediate return. If our research work could be put on the endowment basis, and the foundation sum made large enough to provide a good income, this demand might not be so troublesome.

In England, the government has provided some of the money and that is perfectly fair, because in the long run (as we shall show in another place) the general public will benefit most by the research, and in the end pay for it in one way or another. Unfortunately, perhaps, government support does not seem to be available here, aside from co-operation with certain departments which can render valuable aid.

The general idea behind the English work seems to have been to solve certain practical problems that are general to the trade and to devise new types of machines that anyone who supports the work can use if he will. Real scientific work is necessary for these developments and for certain control tests that have been devised. Except where the application is general, it is not worked out by the association. But, the results of all the work are available to any subscriber who can use them. Therefore, those who are supplied with their own physicists and chemists, that is, the ones who are most enterprising, are expected to obtain many useful points which they can develop, each according to his own ability and requirements.

This illustrates very well one of the main advantages of a large general research program. The results will be available to all and he who is alert will be able to use some of them in his business.

Research should look most attractive to the large textile corporation which can finance its own laboratory on a large enough scale to accomplish something. Such an organization will be in a position to utilize scientific facts sooner than competitors and will find that to be one way in which the laboratory will pay its way.

While already having an advantage over competitors, it might seem a better business policy to discourage any other research effort; but right here is where the great value of such an effort comes in. There are plenty of problems that even the big fellow cannot handle, but he can help support this work somewhere else, suggesting the things on which useful information should be sought, and making use of such fundamental data as suit his requirements, thus extending the scientific facts to practical use and profit. The mill that already has a research laboratory, or even one scientific man, is in a more favorable position to profit from any broader and more fundamental program.

Anyone who has tried to get back of the superficial aspects of the textile problems that come to him will realize the possibilities of such outside assistance.

Returning to the program, we should probably do just about the same type of work that the British associations are doing.

New Bedford Alumni to Hold Annual Outing

The annual outing and final Spring meeting of the New Bedford Textile School Alumni will be held on Saturday, June 14, at the residence of Mr. and Mrs. E. H. Hinkley, 24 Tenny Avenue, Mamaroneck, N. Y. As a fitting climax to the occasion there will be served an old fashioned Nean Supper in the true New England style.

The secretary, Arthur H. Ronne, urgently requests that all the members of the association communicate with him as to whether they will attend. He may be reached at McCampbell & Co., 320 Broadway, New York City, Telephone Worth 5100.

A Nation-Wide Textile Research Institute

A SIGNIFICANT and far-reaching event in the history of the textile industry is the organization of the United States Institute for Textile Research. This was effected at a meeting on Friday, May 23, 1930, at the Chemists' Club, New York City, of representatives of the various branches of the textile industry, textile schools, and governmental bureaus, all of whom came together to formulate plans for establishing a centralized research organization which might serve the needs of the entire industry. The meeting was the outgrowth of several previous conferences initiated by leaders in the textile field throughout the country during the past few months. P. J. Wood, of the Silk Dyers and Printers Association, and Charles H. Clark, of the Textile Research Council, Inc., served as chairman and secretary of the session.

Dr. Elvin H. Killheffer, president of the American Association of Textile Chemists and Colorists, spoke of the attempts that had been made in the past to arouse a general demand for textile research, and remarked that the gathering was singularly representative—the attendance indicating wholehearted interest in a project which would bring about the realization of a common purpose and goal.

Tentative by-laws were submitted, and after discussion were turned over to a specially appointed committee for further study. These provided for the general organization of the Institute, and specified that there should be a governing body of a president and number of vice-presidents; the plan being that there be one vice-president to represent each major group in the textile industry. A board of trustees would be appointed to have as its responsibility the administration of all funds of the corporation. A board of directors, to be composed of at least twenty-four members, is contemplated. This board would provide for representation on an equitable basis for the several units in the textile field. An executive committee, which would be the active functioning body of the corporation, is to be selected from the board of trustees.

The several types of memberships planned are as follows: Founder membership, a minimum of $10,000; benefactor membership, a minimum of $5,000; sustaining, a minimum of $2,500; life, a minimum of $1,000; and annual and associate memberships, $10 a year. It was pointed out that textile corporations can take any class of membership desired, and that different men within the organizations may likewise choose among the memberships those for which they might be most qualified. The associate memberships are provided for those people who although not having a direct interest yet have enough of an auxiliary one to become subscribers to the general chest. The whole idea in the membership set-up is to provide a wide range, and the Institute is thus able to include practically every individual or association concerned with textile research.

The Textile Research Council, Inc., through its representatives, expressed a willingness to turn over to the newly-formed United States Institute for Textile Research the Council's corporate structure. This attitude was appreciated and the suggestion was referred to a committee for discussion and an investigation as to the legal requirements which might be involved.

The board of directors of the Institute were selected in a preliminary way with the following personnel:

Stuart W. Cramer, American Cotton Manufacturers Association; Dr. Elvin H. Killheffer, American Association of Textile Chemists and Colorists; Ernest N. Hood, National Association of Cotton Manufacturers; A. L. Lustig, National Association of Finishers of Cotton Fabrics; Franklin W. Hobbs, National Association of Wool Manufacturers; W. F. Edwards, Silk Association of America; Walter C. Taylor, Southern Textile Association; Charles H. Clark, Textile Research Council, Inc.; Louis A. Hird, The Wool Institute; W. R. Hutz, Silk Dyers Association of America; W. L. Conrad, Textile Division, American Society of Mechanical Engineers; Prof. George B. Haven, Committee D-13, American Society for Testing Materials; P. J. Wood, Silk Dyers and Printers Association; Warren E. Emley, Bureau of Standards, Department of Commerce; Cherry E. Emerson, A. French Textile School, Georgia School of Technology; and Prof. Louis A. Olney, Lowell Textile Institute.

A resolution which was presented to the meeting by Mr. Hobbs, and was adopted was to the effect that the preliminary board of directors of the Institute go on record in favor of the Merritt or Textile Foundation Bill (H. R. 9557) as reported to the Senate by the Judiciary Committee, at the same time urging its prompt adoption by the Senate and President Hoover's signature. The resolution also declared that the board of directors believes that the scientific research needs of the textile industry may be most efficiently served through using the income of the Textile Foundation fund for research in textile lines, keeping the principal intact. The resolution urged that as soon as the board of trustees of the Textile Foundation is appointed by the President, it be requested to hear the arguments of the Institute in favor of these suggestions before any action is taken with respect to the fund.

Following the general organization meeting the temporary board of directors convened to take action on the appointment of a committee to redraft the by-laws, provide for amendments as suggested by members and attend to the necessary details in connection with the name and matters of incorporation.

Charles E. Kaltenbach

Charles E. Kaltenbach, president of the firm Kaltenbach & Stevens, died suddenly in Cranford, N. J., on June 3, 1930. His loss will be keenly felt by the textile industry in which he has played an important role for many years. Mr. Kaltenbach was among the first to apply tin-weighting to piece goods, and contributed much to the methods in use to-day for degumming and textile printing. He was a graduate of Philadelphia Textile School and a charter member of the national textile fraternity Phi Psi.

Mellon Institute Announces Plans for New Building

Dr. Edward R. Weidlein, director, Mellon Institute of Industrial Research, Pittsburgh, Pa., has announced, speaking for the Board of Trustees, that the institution is to increase its facilities by a building project that will permit material expansion of all its research activities.

The building, which is to occupy the site of the Institute's Building No. 2, is designed on classical lines, a plain, simple, but massive structure, surrounded by columns. It will provide ample space for housing many more Industrial Fellowships than the sixty-three that now tax the Institute's facilities to the utmost. The other departments of the institution will be increased in proportion.

When the present home of the Institute was completed in 1915 it was felt that the Industrial Fellowship procedure created by Robert Kennedy Duncan had passed from the experimental to the practical stage. The building, which was given to the institution by Andrew W. and Richard B. Mellon, incorporated the best laboratory constructional features of that period. It was thought then that it would provide adequate space for growth for many years; but for practically 10 years the Institute has had a waiting list of companies, often almost as long as the roster of companies whose problems were being investigated. Even the additional space afforded by Building No. 2, acquired in 1927, gave but temporary relief from the need for more laboratories arising from proposed new investigations and from the necessity of increasing the personnel of fellowships already in operation.

In addition to providing a greatly increased number of laboratories, the new building will give more commodious quarters for the general departments. The present library contains 11,000 volumes; the new library is planned to accommodate 250,000 volumes. The present Department of Research in Pure Chemistry will be expanded and facilities for pure research in other branches of science will be provided. Much more elaborate chemical engineering laboratories are to be available in the new building, and also the fellowships in each specific field of industrial research are to be grouped in suites of rooms so that they can best make use of general apparatus adapted to their needs. Certain rooms will be equipped for specialized phases of experimental technique, such as electrochemistry, spectroscopy, low-temperature studies, radiations, high-pressure experimentation, etc. Other special features to be included are a large lecture hall, a dining hall, an industrial fellowship museum, and an underground garage. For the past five years members of the Institute's executive staff have been visiting important laboratories in America and Europe to obtain information on new features in design and equipment.

The new laboratory structure will be of that type of classical Greek architecture known as Ionic. It is to be seven stories high, with monolithic columns along all four sides. The proportions will be approximately 300 feet by 400 feet. The main entrance, which is located on the third floor, is reached by steps extending along the entire front of the building. The laboratories are to face on interior courts. The design of the new building is to be such that additional laboratory suites can be constructed in the interior courts without marring the beauty of the general appearance and without interfering in any way with the original laboratory units.

National Color Conference

On Wednesday, May 14, a meeting was held at the Hotel Willard in Washington, D. C., which promises to be of great significance to persons interested in color. This meeting resulted from the activities of a special subcommittee appointed by the U. S. Pharmacopoeial Revision Committee in 1927 to study the question of standardizing the color names in the U. S. Pharmacopoeia.

Chiefly owing to the efforts of Dr. Edmund N. Gathercoal, Professor of Pharmacognosy at the University of Illinois School of Pharmacy, this special committee published a very comprehensive report which included not only a discussion of the use of color names in the U. S. Pharmacopoeia, but in addition gave a résumé of the historical developments in the description of color and a brief outline of the various methods of color measurement.

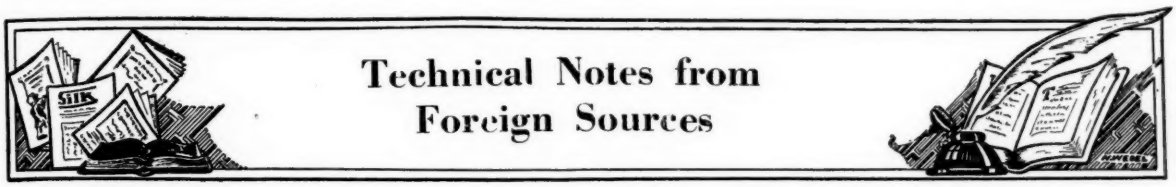
Realizing their inability to find an adequate solution of this problem by themselves, they decided to inaugurate a movement which should include all branches of the arts, sciences, and industries which are interested in color. Hence, a large number of invitations were issued to attend a color exhibit and a color conference to be held in connection with the twelfth gathering of the U. S. P. convention.

The color conference was presided over by Dr. Gathercoal as temporary chairman. After a discussion of the need for a national body to bring order out of the present chaos of color names, it was decided to take steps to inaugurate such an organization. Accordingly, the chairman appointed a nominating committee consisting of Dr. Walter M. Scott, service director of the Munsell Color Company, and Dr. George D. Beal, assistant director at the Mellon Institute, to present to the meeting a list of about ten individuals, representing different fields of interest, to constitute a temporary executive committee.

The personnel of this executive committee was as follows: Dr. Edmund N. Gathercoal of the Illinois School of Pharmacy; Dr. Herbert W. Younken of the Massachusetts College of Pharmacy; Dr. Deane B. Judd of the Colorimetry Section of the U. S. Bureau of Standards; Dr. H. V. Arny, Professor of Pharmaceutical Chemistry at Columbia University; Dr. F. F. Rupert, Industrial Fellow at the Mellon Institute; William D. Appel of the Textile Section of the U. S. Bureau of Standards; Mrs. Margaret Hayden Rorke, managing director of the Textile Color Card Association of the United States; Charles Bittinger, artist and scientist; Royal B. Farnum, director of the Rhode Island School of Design; Raymond P. Ensign, director of the Newark Public School of Fine and

Industrial Arts; and A. E. O. Munsell, publisher of the Munsell Book of Color.

The election of the temporary executive committee, as constituted above, was confirmed and they were instructed to draft a constitution and by-laws for a National Color convention. The meeting then adjourned with the understanding that the next meeting would be called at the discretion of the temporary executive committee as soon as they were ready to perfect their plans for a permanent organization.



Textile Soap Problems

R. Manschke—Monatsch. f. Textil-Ind. 45, 33 (1930). —An interesting paper (to be continued), much of which is worth quoting. The idea often expressed, that "in the textile industry any kind of soap will do, is an error. Great care is necessary, not only in the choice of the oils and fats to be worked up into the soap, but also in their saponification. In the West Riding district (England), in which numerous mills produce the most varied fabrics, soaps of a more or less varied composition are demanded. These soaps are of the most different sorts; often, however, they consist simply of soda soap, which has been scooped out of the boiling-kettles directly into the containers. An analysis of one such soap, filled into the container directly, showed 15.1% of fatty acids, 2.1% of combined alkali (Na_2O), 0.3% of insoluble matter (dirt), 1.6% of unsaponifiable fatty matter, 80.5% of water, and 0.4% of free caustic soda. This soap, used for the scouring of wool, contained, therefore, only about 17% of actual soap. The fatty acids or resin acids were composed of about 30% colophony and 70% of whale-oil or fish-oil. According to their nature, they may or may not exert an unfavorable influence upon the fiber. Whether so or not, such a soap presents a source of great danger, if it is not entirely washed out in the washing. If dried in only small quantities upon the wool, such a soap would produce, not only a bad-smelling, but also a brittle wool, as a result of the presence of resinous, unsaponifiable matter. Since the abietinic anhydride in colophony is easily changed to the acid by caustic alkali, the soap containing it would be easily soluble and possess a high detergent power; but it would show also a high percentage of unsaponifiable matter, and would always be soft and "rosiny." Through a study of different grades of colophony, the author has found that the unsaponifiable matter ranges between 5% and 15%. Then, too, in the soap mentioned above, the 9.4% of free caustic soda is highly dangerous, if the bath is to be used for some time. Such products are therefore to be avoided. Soaps for wool scouring must above all be free from colophony, if they are to be employed upon cross-bred or the finest Botany wool, and, further, should contain no drying oils, such as linseed or soya bean oil. Linseed oil is, indeed, often used for soft potash soaps, but it may conceivably leave behind (in connection with the lanoline fatty acids) an odor or color which can oftentimes not be removed even by good rinsing of the wool in soft water. If the wool is to remain undyed, and used for "white" weaves, the greater cost of such potash soaps is outweighed by the better condition of the weaves.

A hard soda soap, of good quality, studied by the author contained 63.7% of fatty acids, 8.1% of combined alkali (Na_2O), 0.1% of free alkali (Na_2O), and 28.1% of water. The fatty acids contained no colophony, but principally good tallow, bleached palm-oil, and some palm-kernel oil. The soap had a handsome white color, was of very firm consistency, and developed a pleasant odor on boiling. A good potash soap for wool-scouring was composed as follows; 44.1% of fatty acids, 7.4% of combined alkali (K_2O), 0.15% of free alkali (K_2O), and 48.35% of water. This soap was also fully free from colophony, and showed all the constants and reactions of a soap made from good olive oil. It possessed a yellowish-green color, was transparent, and contained just so much free alkali as was permissible for a continuous bath. In case of a hard soda soap for wool of all kinds, we should have to regard as our ideal a content of free caustic alkali of not over 0.1%, and a fatty acid mixture consisting of good English tallow and bleached palm-oil, beside a little palm-kernel oil. With dirty cross-bred wool, more soda-ash can be added to the bath. Free alkali carbonate is not dangerous, in a reasonable sense, in so far as it is not used in excess, and the water is not too hard. In the scouring of Botany wool, much less soda-ash and more soap is needed. There can be no doubt that caustic, especially caustic soda, harms luster and color of the wool if present in perceptible quantities.

In washing yarns, especially those which are to be worked up into white goods, soft potash soap is the best, and particularly that which has been prepared from only good olive oil, and contains not more than 0.1% of free caustic alkali. An excess of caustic alkali, of either kind, brings about yellowing, which, according to the author's experience, sets in at the temperature of the bath even in cases of only 0.4% caustic content, and increases in intensity with rising temperature of the bath. If white wool or white yarn is over-bleached with sulphur, then, in the presence of alkali, there is a specially strong inclination toward yellowing. In reference to the content of

free alkali, it is of particular advantage to add to the soap-bath ¾% of sodium perborate, if the wool or yarn is to be washed after bleaching. The tone is improved, and a more stable white attained, by this means.

Experience has shown that the following are most suitable for wool-soaps: tallow of best quality, olive oil, palm kernel oil, Ceylon cocoanut oil, and bleached palm oil. Naturally, the detergent power of wool soaps is highly important. This factor stands in certain relations to solubility, yet no exact relationship appears to exist. Sodium oleate is soluble in 10 parts, sodium stearate in 100 parts, of water. This, in the case of olive oil, means a rapid formation of suds; in the case of tallow or palm oil, a lasting action of the bath. In dependence upon this fact, the oils and fats should be mixed in suitable proportions. In the Bradford district, for wool of all kinds, the following mixtures are used with excellent results: (1)—60 parts of H. M. tallow (titer 43.5° C.), 20 parts of (technical) olive oil, and 20 parts of palm-kernel oil or Ceylon cocoanut oil; (2)—as a cheaper mixture, 50 parts of H. M. tallow, 30 parts of bleached palm oil, and 20 parts of palm-kernel oil or Ceylon cocoanut oil.

A cotton-seed oil soap (used in a certain mill), which was sent to the author for analysis, contained too much free alkali and an excess of unsaponifiable fatty substance; in this case, the caustic soda was what occasioned the difficulty. In another case, a sample of a cotton-seed oil soap-bottoms, which had afterward been boiled with caustic soda and finally salted, had the following constitution: 51.2% of fatty acids, 32.7% of water, 3.4% of caustic soda (NaOH), 6.2% of organic material, including albumenoids and unsaponifiable fatty substances, 2.7% of insoluble coloring matter, including dirt and sand, and 3.8% of glycerol. The mass was of dark color, and possessed a disagreeable odor of methylamines, on which account the soap was unsuitable for wool of good quality. Such a soap would be quite usable for a cheap washing-powder for household use, if dried, ground, and mixed with soda-ash. Formerly, large quantities of soap with a cotton-seed oil base were used for washing wool of a poor grade; to some extent this is still the case with cross-bred wool of lesser value; but the method is rapidly dying out. When used, the excess of alkali causes many difficulties to be encountered with the wool—bad odor, yellowing of the white wool, and uneven dyeing of weaves made from it.

Some practical advice is given upon the choice of oils—tallow, light yellow to white, with a titer of not under 43.5° C.; bleached palm oil, preferably Lagos oil, because this is most easily bleached satisfactorily in air, and has the lowest content of free acids, possessing an average titer of 45° C.; and New Calabar palm oil, which is next best. Salt Pond palm oil is to be avoided; it has a high content of free acids, which make a good air-bleaching impossible. Of the cocoanut oils, the Ceylon is the best, the Cochin China and Malabar coming next.

In reference to one or two other points, a method which is fortunately going out of use consists in the boiling of "olein" with soda ash for producing what is called a soap. Even the title of such a source is misleading, since not all fatty substances designated as olein consist of oleic acid. Such a soap is conceivably not sufficiently boiled, to say the least. If the olein, also, does not consist entirely of fatty acids, then such a soap would simply add unsaponified material to the bath, with resultant serious difficulties. A number of such "oleins" have been investigated by the author. "Undistilled olein" from Belgium was the best one examined; it contained 96.8% of free fatty acids in the form of mostly oleic acid, beside 2.2% of stearic acid and 1% of dirt and water. An oil of this nature could be completely converted into soap by soda ash, with a little care, but its detergent power would be questionable. Other samples of olein contained as much as 37.3% of neutral fats, so that any attempt to convert them into soap by means of soda ash would be useless. A sample of "brown olein" contained 69.4% of free oleic acid, 23.1% of saponifiable, free stearic acid, and 7.5% of unsaponifiable material. Saponification of the oil with soda ash would be difficult. The high content in unsaponifiable material would make it unsuited for soap for any purpose. Examination showed the unsaponifiable material to be "cholesterine" or wool-fat. The author can only advise against the use of any soaps prepared by the method in question; many difficulties practically encountered in dyeing and finishing are to be traced back to the use of such soaps. Most of these difficulties are to be ascribed to the excessive alkalinity of these soaps (though due only to carbonate); but some also to the unsaponifiable material.

Another bad point of practice (also going out of use, to the great advantage of the textile industry) consists in working up into soap the fatty material obtained by acidifying the spent soap baths. Thus, the "Yorkshire fat," obtained from the waste soap-lye of wool-scouring, should not be used for the re-preparation of soap, since it contains 10-15% of unsaponifiable matter. Another fatty material, called "fuller's fat," obtained likewise by acidifying soap-liquors, frequently contains a whole series of unsaponifiable material, derived from the oils used in carding and spinning. One such material, obtained from the Huddersfield district, contained 1.1% of water, 77.4% of saponifiable oil, and 21.5% of unsaponifiable material. The author has also investigated samples of "fuller's fat" which was mixed with olein and then boiled with caustic soda as well as with soda ash, and in no case did he find less than 3.7% of unsaponifiable material. Such a soap would give no lustrous, clean wool, and would leave behind a very unpleasant, musty odor. It contained, inter alia, 95% of saponifiable oil and 3.7% of unsaponifiable fats.

Acetyl-Cellulose

Dr. K. Rocs and Dr. H. Friese—Kunst-Seide 12, 11 (1930).—A most interesting and ably-handled paper, which begins with purely chemical considerations and ends with a discussion of the industrial situation regarding

fiber-production from this and other sources. The latter part may be passed over (it deals mostly with the figures for the increasing annual world-production of acetate silk and other artificial and natural fibers); but a number of points in the earlier section of the paper deserve attention.

It appears that in the carbohydrate group the various acetates, which in the pure state are insoluble in a particular solvent, are often easily soluble if they are accompanied by small amounts of by-products. If such "soluble" acetates are purified by repeated precipitation and resolution, their solubility decreases until insolubility is reached. Now, sulphuric acid very easily brings about degradation ("Abbau") of cellulose. Even at a low concentration a product is formed in the process of acetolysis, which, in spite of its content of acetic acid, varies from tri-acetyl-cellulose by as much as 62.5%. It gives a good, clear solution in acetone, but the solution possesses poor viscosity. In the stepping-down process, as the deacetylation reaction may be called, the formation of cellobiose acetate has been detected, as one of the earliest-occurring steps. If such substances form, even to only a slight extent, in acetylation (it must be remembered that when sulphuric acid is used in the acetylation of cellulose, it can play a two-fold part, as an assistant to the acetylation-reaction, and as a substance which can at the same time partially deacetylate the acetyl-derivative as it is formed), it is not hard to understand how its presence may affect solubility and viscosity of the principal product, the "cellulose acetate."

In reference to what was mentioned above, if cellulose tri-acetate is dissolved in glacial acetic acid or chloroform, and precipitated with ether, the precipitated product is no longer completely soluble in glacial acetic acid. If the solution and precipitation are repeated several times, the final product is insoluble in all media. The explanation is, evidently, that in this process the "solventizing impurities" remain in the solvents used, and the cellulose acetate, as it becomes more pure, begins to display its characteristic insolubility more and more. It has recently been found possible to acetylate cotton with acetic anhydride in the presence of pyridine, in which case hydrolysis can not take place, and the fiberous structure remains intact. Such a product is insoluble in any medium, as would be expected.

Similarly, starch-acetate, when prepared very carefully, is absolutely insoluble. If it is subjected to the action of hydrolyzing agents for a short time, it becomes soluble in acetone, and its viscosity is such that very good films can be produced from it. It seems, therefore, plain enough that it really is the presence of degradation products which accounts for the solubility of insoluble acetate of this group. The degradation products, which seem to be most effective in rendering the still pure acetate soluble, contain free hydroxyl groups, due quite evidently to the complete acetylation and subsequent deacetylation of some of the acetate groups; and perhaps the changes go still further.

In regard to the structure of the molecule, and such questions, Nageli holds that such natural substances as cellulose do not consist merely of single molecules united into substances in the manner in which such union usually exists (of which we really can say nothing without falling into the pit of "views"), but that a considerable number, about 30-50, molecular residues are united into a chain through primary chemical valences, so that a single molecule of cellulose is of considerable size, though its components are of what might be called monomolecular dimensions. He further holds that the same number of these chains unite to form a micelle, so-called. It may well be that the assumption of the primary molecules being first aggregated to chains is unnecessary; that is, that the molecules themselves unite directly to form the micelles. These views have been developed by Meyer and by Mark. Now, granting that the foregoing is in general true, if we assume that in the process of acetylation and hydratation the micellular union "loosens up," as a result of the formation of degradation-products, then there is a possibility of the solvent, e.g., acetone, being able to penetrate into the interior of the micelle and here and there to split it apart, since the components of the micelle are not united by chemical affinity. So, swelling and solution may take place as a result of this intimate penetration. The degradation-products so often mentioned act, to a certain extent, catalytically in the act of solution of the cellulose acetate; and a chemical breaking-down of the cellulose molecule-skeleton does not take place, apart from the small amounts of degradation-products formed. Colloido-chemical relations are possibly involved, but at present any statements made with these in view must be branded as rashly theoretical.

In practical work, the formation of such degradation-products is so far favored as to confer upon the product the power of becoming dissolved; and no farther. It may easily be understood why such emphasis is placed upon the formation of the primary acetate; for, if more hydrolytic products are formed than are necessary for conferring this solubility upon the product, the acetate on subsequent hydratization is still further broken down, being of little resistivity; and the viscosity of the product sinks to a corresponding degree; fibers spun from it have little strength. This would explain why we do not get the same acetone-soluble products when the acetylation is interrupted at a point where the acetic acid constant is about 50-56%. The hydrolysis cleavage outsteps the acetylation, and, as long as the latter is not attained, the degradation-products requisite for solubility are not formed. It is a well-known fact, too, that a strong catalyzer or a high temperature during acetylation, if carelessly allowed, produces acetate of a low viscosity. The success of acetylation depends upon the correct amount of catalyzer, exact control of temperature, and duration of the acetylation. There are no reactions known which can be utilized as controls during the acetylation, so that we have simply to find the ideal conditions and to stick to them.

A number of very interesting facts as to solubilities, methods of analysis, etc., are given, and a few facts regarding esters other than the acetates. Thus, the for-

mates, prepared easily with formic acid plus a catalyzer, formic anhydride being out of the question, are of no value for spinning, being soluble only in formic acid, pyridine, and aqueous acids, as well as in acetic and lactic acids. Regarding esters higher than the acetates, not much is known, save that they exist, and are prepared in the same general way as are the acetates. They are too expensive to prepare, and there are no solvents practically suitable for them. It is to be suspected, too, that the introduction of heavy radicals into the cellulose may well occasion the loss of those properties necessary for the success of the spinning operation. But the chemistry and technology of such esters is still in the elementary stage.

1930 Fall Silk Colors

The confidential advance Floss Card showing the eighty colors which will later appear on the regular 1930 fall season card will be issued to members of the Textile Color Card Association shortly, according to an announcement by Margaret Hayden Rorke, managing director of the Textile Color Card Association.

In addition to the newest color families for daytime costumes, arranged in gammes of three and four shades, a special feature of the card will be a group of twenty-two "Directoire" colors particularly adapted to evening wear and blouses. The shades suitable for blouses have been carefully chosen to harmonize or smartly contrast with the basic color note in the ensemble.

From this card, as well as from the 1930 fall woolen card, the Associated Dress Industries of America and the Allied Millinery Associations have chosen the colors they will sponsor for the coming fall and winter seasons. The selection of dress colors was made first, thus serving as a guide to the millinery group in choosing shades which coordinate closely with the fashionable colors in costumes. Likewise, the shoe colors have been keyed to the outstanding shades in textiles.

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i.e., help wanted, machinery or supplies for sale—the rate is $5.00 per column inch or less per insertion.

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As Sales Manager or Manager of Branch office. Over 20 years' experience in the Dyestuff and Chemical Business. Five years Branch Manager. Conversant with Imported as well as Domestic Dyestuffs, their application and properties. Have traveled here and in Foreign countries as Salesman and Demonstrator. Best of references. Address Classified Box No. 600, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

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Dyestuff Salesman with many years of Sales and Laboratory experience is desirous of a suitable position with Manufacturing concern. Advertiser has an extensive personal connection in various States and can give first-class references. Reply to Classified Box No. 608, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

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Modern progressive bleaching, mercerizing, dyeing and finishing cotton piece goods plant in Piedmont Carolinas has opening for chemist. Applicant must have ability, ambition, initiative, as well as thorough chemical education and training. Must be able to cooperate with department heads. Replies will be treated strictly confidential. Please state age, nationality, family connections, as well as experience, and give reason for desire to change position. Specify salary expected. Classified Box No. 612, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.